PROGRESS IN SOIL AND WATER CONSERVATION RESEARCH

a quarterly report

Soil and Water Conservation Research Branch
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FOREWORD

Additional suggestions relative to increasing the usefulness of these reports are solicited. A number of suggestions received but not put into effect are still under consideration, especially those which mutually conflict to some extent. One important suggestion which will be implemented is that sources of additional information should be cited whenever this is deemed to be possible and helpful. Also, efforts will be made to indicate more clearly whether results reported are relatively conclusive or inconclusive.

The material presented here is for in-service use only.

The Soil and Water Conservation Research Branch carries on its work cooperatively with State Agricultural Experiment Stations.

STAFF MEMBERS
Soil and Water Conservation Research Branch

The two top rows are staff members of the Watershed Hydrology Section. They are as follows: Upper row (left to right)--H. E. Middleton, Assistant Head, and Project Supervisors Lloyd L. Harrold, Coshocton, Ohio, Robert B. Hickok, Albuquerque, N. Mex., and John A. Allis, Hastings, Neb.; middle row--Project Supervisors Russell Woodburn, State College, Miss., Ralph W. Baird, Waco, Tex., George A. Crabb, Jr., East Lansing, Mich., and Fred W. Blaisdell, Minneapolis, Minn.

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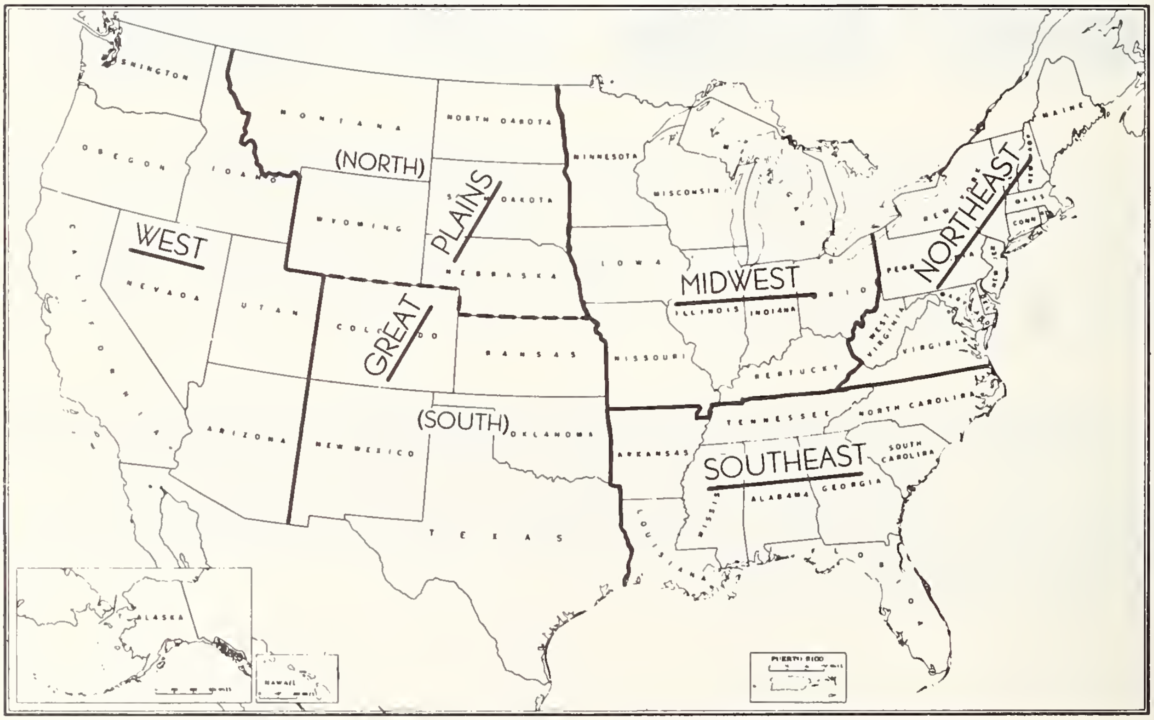
RESEARCH LIAISON REPRESENTATIVES




Four of the five Research Liaison Representatives stationed in the field are pictured above. They are, left to right: John Lamb, Jr., New Brunswick, N. J., Northeast; R. Y. Bailey, Auburn, Ala., Southeast; D. M. Whitt, Columbia, Mo., Midwest; and Allen F. Kinnison, Riverside, Calif., West. Not pictured is Charles J. Whitfield, Fort Collins, Colo., Great Plains.

The Research Liaison Representatives report administratively to the Assistant Administrator for Field Services, Soil Conservation Service, but are jointly employed by SCS and the Agricultural Research Service to help the two agencies work together closely in meeting conservation problems. Their duties include work on these quarterly reports.

STATE GROUPINGS USED IN THIS REPORT*



* These groupings are used by Soil Conservation Service for plant technology servicing.

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SOIL AND WATER MANAGEMENT

IRRIGATION

Northeast

Virginia. Irrigation requirements and practices for crop production. J. Nick Jones, Jr., and John E. Moody, Blacksburg.

(1) Irrigation Improves Yield and Quality of Burley Tobacco in Virginia

Irrigation of Burley tobacco during 1954 at Blacksburg, Va., increased the average yield 857 pounds per acre and the average market value of all grades by $4.00 per 100 pounds, resulting in an average increase in value of the crop of $513 per acre. Furthermore, 3½ inches of water applied from the time the tobacco plants were knee high until bloom was just as effective as additional amounts of irrigation water before or after this period.

Data upon which these conclusions are based are given below:

Burley tobacco yields and values per acre associated with three irrigation practices and no irrigation, Blacksburg, Va., 1954

Period of irrigation	Irrigation applied 1/	Yield per acre 2/	Value	
			per cwt.	per acre
	Inches	Pounds	Dollars	Dollars
No irrigation.................	0	2879	42.18	1214
Knee high to bloom	3.5	3790	45.78	1735
Transplanting + knee high to bloom.................	4.25	3674	46.43	1706
Continuous through season....	8.0	3743	46.46	1739

1/ Rainfall (June through September) 9.96 inches.
2/ Average of two plant spacings.

Irrigation applications were made whenever 50 percent of the available soil moisture in the root zone was depleted during the specified period of growth. Plaster of Paris moisture blocks placed at 1-, 2-, 3-, and 4-foot depths were used to determine the soil moisture depletion and 1 inch of water was applied at each irrigation.

The moisture block resistance data indicate the probable reason for the lack of yield differences between irrigation treatments. The root zone of unirrigated plots showed little moisture deficiency before the plants were knee high. The continuous irrigation treatment received only one application (on September 7) after blooming, and this apparently was too late to affect yield or quality.

In the same experiments, two plant spacings were studied. Plants were spaced 10 inches apart in one (14,935 plants per acre) and in the other, 15 inches apart (9,957 plants per acre). Without irrigation, the 10-inch spacing did not increase either the yield or market value of the tobacco over the 15-inch spacing. With irrigation, however, the 10-inch spacing increased the yield by 339 pounds per acre and the market value by $187.

(2) Direct Relationship Shown Between Corn Yield and Amount of Water Applied

Data obtained at Blacksburg, Va., during 1954 show that a small amount of irrigation water, properly timed, can result in a considerable increase in corn yields during dry years.

The results, listed in the table following, show a continuing increase in yield with increasing amounts of irrigation water. The greatest increase per unit of water applied came with the smallest irrigation application. Direct comparisons of increase per unit of water are not strictly logical in this case, however, since irrigation at different periods of growth were involved as well as different amounts of water. The applications were scheduled whenever available soil moisture was depleted to 50 percent level, except for the early growth period in Treatment B when depletion to 25 percent level was allowed, as indicated in the footnote.

Corn yields associated with three irrigation practices and no irrigation, Blacksburg, Va., 1954

Period of irrigation	Irrigation applied 1/	Yield per acre 2/	Increase per acre from irrigation
	Inches	Bushels	Bushels
X No irrigation...............	0	64.64	---
A Tasseling through milk......	3.0	102.41	37.77
B Early growth 3/ + tasseling through milk..............	6.0	119.15	54.51
C Continuous through season...	10.5	128.17	63.53

Plant population 15,240 stalks per acre.
1/ Rainfall (May through September) 12.58 inches.
2/ Yield based on 15.5 percent moisture.
3/ Irrigated at 25 percent available moisture during early period.

Plaster of Paris block data showed that there was less than 25 percent available soil moisture at the 12-inch depth in the unirrigated plots from about June 25 to July 20. The yield increase of treatment B over that of treatment A resulted from two irrigations during this period. In this experiment, it was not possible to evaluate directly the returns from these two applications before tasseling in comparison to two after tasseling, but two between tasseling and milk stage (treatment A) produced more than two-thirds of the total increase resulting from the four applications (treatment B). This suggests the possible advantages of timing irrigation applications to critical periods of growth to obtain favorable results with limited application of water.

Southeast

South Carolina. Corn irrigation. O. W. Beale and C. M. Lund, Clemson.

Irrigations with 8.1 Inches of Water Worth 78 Bushels of Corn in 1954

Minimum irrigation of corn produced unusual yield increases in 1954 when rainfall during the growing season was only about one-third of the amount usually received. Unirrigated plots produced no marketable corn while an average yield of 78 bushels per acre was produced by an average of 8.1 inches of irrigation water in three irrigation treatments.

Two of the treatments provided irrigation throughout the growing season as follows: M1--whenever corn wilted by 10 a.m.; M3--whenever soil moisture content dropped to 25 percent of the available moisture-holding capacity. In treatment M2 the corn was irrigated on the same basis as M3 but only during the period following tasseling. Yield increases from irrigation were proportional to amounts of water applied. The long-time average rainfall during the growing period is 19.2 inches, while for 1954 it was only 6.6 inches.

Three fertilization variables were employed in all irrigation treatments, the range being from 500 pounds of 4-12-12 plus an additional 62 pounds of nitrogen per acre to 1,000 pounds of 4-12-12 and 124 additional pounds of nitrogen. No significant effects of fertilization on corn yield were measured for these variables.

The following table gives the yield data summary for the experiment. Costs and returns were calculated on the basis of $4.00 per acre-inch of irrigation water and $1.60 per bushel for corn.

Irrigation of corn: Amounts and costs of water applied, corn yields, and calculated gross and net returns, Clemson, S. C., 1954

Treatment	Water applied	Cost of water per acre	Corn yield per acre	Returns from irrigation	
				Gross per acre	Net per acre
	Inches	Dollars	Bushels	Dollars	Dollars
M1..........	8.3	33.20	75.0	120.00	86.80
M2..........	6.9	27.60	69.0	110.40	82.80
M3..........	9.2	36.80	90.0	144.00	107.20

Great Plains

Nebraska. Influence of different irrigation practices on the production of field beans. O. W. Howe, Associate Agricultural Engineer, Scotts Bluff Experiment Station, Mitchell.

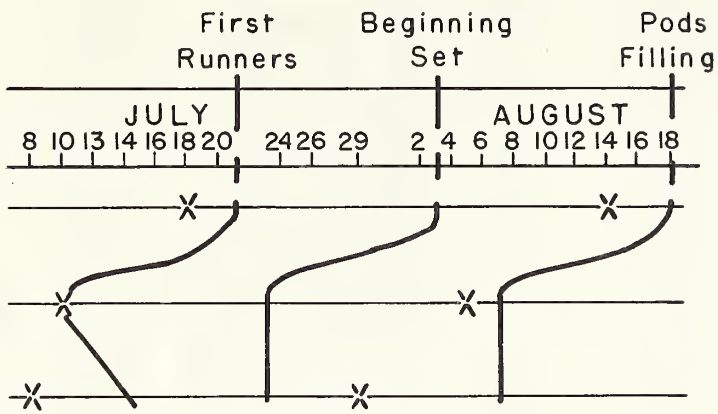
Properly Timed Irrigations Important for Bean Production

Experiments on the irrigation of beans at the Scotts Bluff Experiment Station have indicated that this crop is often over-irrigated in western Nebraska. Failure of beans to respond favorably to a particular irrigation appears to result from some combination of the following factors: (1) Stage of growth of the crop, (2) weather (temperature, humidity, sunlight intensity), (3) amount of moisture in the soil. (No plots are irrigated until the soil moisture tension reaches 400 cm. H_2O at the 6-inch depth.) Irrigation during a prolonged cool, cloudy or humid period usually resulted in little or no increase in yield and sometimes even depressed yield. The data thus far collected are inadequate to explain all of the differences that have resulted from the different irrigation treatments.

Three irrigations gave maximum yield in three years' tests at the Scotts Bluff Experiment Station. Two irrigations resulted in 95 percent of maximum yield when those irrigations were properly timed. One of the two irrigations was applied early--when the available soil moisture at the 6-inch depth was approximately at 50 percent of field capacity--and the other application was made when the pods were filling, or earlier if plant growth had practically ceased due to high moisture tension.

An early irrigation was highly important in these tests. In each of the seven irrigation experiments that have been conducted with beans at the

YIELDS OF GREAT NORTHERN FIELD BEANS OBTAINED WITH TWO PROPERLY TIMED IRRIGATIONS. MITCHELL, NEBRASKA



JULY AND AUGUST * MEAN TEMP.	JULY AND AUGUST * RAIN INCHES	YEAR	YIELD BU./A	% OF MAX. YIELD **
68.5	2.4	1950	49	99
71	2.9	1953	41	94
74	4.8	1954	41	92
72	3.0			

X Indicates time of an irrigation.

* 44 year mean.

** Maximum yield refers to the largest yield obtained in each irrigation experiment.

Scotts Bluff Experiment Station the highest yielding treatment included the early irrigation. In the accompanying chart the earlier experiments are not included because they were not designed to show the most effective timing of two irrigations.

In these tests the subsoil was well supplied with moisture at planting time. After the first irrigation, beans thrived on subsoil moisture in time of drought. Considering only the water that went into the soil, two irrigations saved only one or two inches of water compared with three or four irrigations. If water lost through runoff and ditch loss had been taken into account the saving under a two-irrigation practice would have been considerably greater.

The chart indicates that the mean July-August temperature influenced the adequacy of two irrigations--the lower the mean, the more nearly adequate were only two irrigations.

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South Dakota. Irrigation investigations on Redfield Development Farm. Niel A. Dimick, Brookings.

Crops Take Ninety Percent of Their Water from Upper Three Feet of Soil

In 1954, as in previous years, consumptive-use research showed that approximately 90 percent of the soil moisture used by crops was removed from the upper 3 feet of the soil profile. From the 0-1, 1-2, and 2-3 foot layers, the percentage use was 55, 21, and 14, respectively. These values are the over-all averages for all the crops and vary somewhat from one to the other according to their individual rooting habits.

Data were again computed only from those periods of the growing season when it was reasonable to assume any precipitation that fell penetrated no farther than the upper foot and thus was consumed from this layer.

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Texas. Irrigation and drainage studies. Norris P. Swanson, Irrigation Engineer, Bushland.

(1) Earth Moving Changes Soil Moisture Storage Capacity, Not Intake Rate

In field trials with Soil Conservation Service technicians, Area 7, it was found that leveling and moving deep and medium textured soil from a 1.5 percent slope into 75-foot benched borders did not materially affect the water intake rates. However, the moisture storage capacity of the soil on the fill sides was increased at the expense of the cut areas.

(2) Water Use by Cotton and Sorghum Influenced by Irrigation Practice

Consumptive use data from research plots in Swisher County near Tulia, Texas, are included in the two tables that follow. This is off-station research from the Lubbock Substation of the Texas Agricultural Experiment Station. The 1954 growing season was hot and dry but did not include a prolonged period of daily temperatures in excess of 100°F as did 1953 and, to a lesser extent, 1952. As a result, the seasonal consumptive use figures for cotton and grain sorghum in 1954 were somewhat lower than in 1953.

Cotton yields were directly related to amounts of water available. Plottin yield figures against inches of water gives nearly a straight line. Available moisture apparently should be maintained in the 0- to 24-inch soil depth until a later date than August 15. This year practically all of the available water had been extracted from the 72-inch soil profile by early September despite some effective late August rainfall. It is reasonable to believe that an additional irrigation would not have provided detrimental late season growth even with normal September precipitation.

Grain sorghum plots receiving irrigation (treatments B, C and D) did not exhaust the available water in the soil profile, leaving from 4.2 to 6.0 inches in the 72-inch depth. These plots were not fertilized; a grain sorghum fertilizer study conducted by Earnest Thaxton of the Lubbock Station on identical plots using the same irrigation treatments as D yielded in excess of 5,200 pounds of grain compared with 3,173 pounds in this study, with about the same water use.

Cotton yields per acre and consumptive use of water with four irrigation practices at off-station irrigation research plots, Tulia, Texas, 1954

Treatment	Water applied after planting		Total water 1/	Yield of lint per acre	Yield of lint per acre-inch of water
	No. irrigations	Inches	Inches	Pounds	Pounds
A. Preplanting only........	0	0	13.9	326	23.5
B. Maintain 25% available water in 0-24" depth to Aug. 15................	2	8.0	21.9	477	21.8
C. Maintain 50% available water in 0-24" depth to Aug. 1.................	2	7.5	21.4	519	24.3
D. Maintain 50% available water in 0-24" depth to Aug. 15................	3	11.5	25.4	562	22.1

1/ Including 0.9 inch of available water in soil at time of applying a 6.5-inch preplanting irrigation in late April, 2.3 inches of May rainfall prior to planting, and 4.24 inches during growing season, a total of 13.9 inches. The plots were level and there were no runoff losses. At planting the soil profile was at field capacity to a depth of 60 inches throughout the field and to 72 inches at many sampling points. The 72-inch soil profile was at the wilting point at harvest.

(Data cooperatively obtained with the Lubbock Substation of the Texas Agricultural Experiment Station.)

Grain sorghum yields per acre and consumptive use of water with four irrigation practices at off-station irrigation research plots, Tulia, Texas, 1954

Treatment	Water applied after planting		Total water1/	Yield of grain per acre	Yield of grain per acre-inch of water
	No. irrigations	Inches	Inches	Pounds	Pounds
A. Preplanting only........	0	0	13.9	1283	92.4
B. Maintain 25% available water in 0-24" depth to Sept. 15...............	3	12.0	20.5	2825	137.8
C. Maintain 50% available water in 0-24" depth to Sept. 1................	3	11.0	20.7	2990	144.4
D. Maintain 50% available water in 0-24" depth to Sept. 15...............	4	15.0	22.9	3173	138.5

1/ Including 0.9 inch of available water in soil at time of applying a 6.5-inch preplanting irrigation in late April, 3.2 inches of further rainfall before planting, and 3.43 inches of rain during the growing season, a total of 13.9 inches. The plots were level and there were no runoff losses. At planting the soil profile was at field capacity to a depth of 60 inches throughout the field, and to 72 inches at many sampling points. The 72-inch soil profile at harvest contained the following amounts of available moisture which were subtracted: Treatment A, 0 inches; treatment B, 5.4; treatment C, 4.2; and treatment D, 6.0 inches.

(Data cooperatively obtained with the Lubbock Substation of the Texas Agricultural Experiment Station.)

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Colorado. Irrigation water application and drainage of irrigated lands in Upper Colorado River Basin. M. M. Hastings, M. Amemiya, and C. W. Robinson, Grand Junction.

Plots Irrigated with 12 Inches per Acre in Excess of Consumptive Use

In 1954, 33 plots each 160 feet long and 60 feet wide were used to start a rotation experiment containing corn, beets, barley, and alfalfa. This progress report covers the effect of the water application during the 1954 irrigation season on the ground water levels in the experimental plot area.

By the use of a Sparling meter for measuring gross application and a Parshall flume equipped with water stage recorder for measuring waste, the

net application of water to each crop was found and tabulated (see table). Those values are compared with the consumptive use requirements for the Grand Valley as determined by the Blaney-Criddle method.

In the irrigation of the beets, the initial application for germination had to be excessive in order to get moisture to the row. Lateral movement was extremely slow, and long periods of application were required. Downward water movement was more rapid, resulting in the excessive application as shown in the table. Alfalfa in the barley-alfalfa plots was given an extra irrigation after the barley harvest, accounting for the difference of water application between the barley and the barley-alfalfa plots.

Approximately 12 acre-inches per acre in excess of consumptive use requirements was applied to the experimental area. Even with this excess water, the ground water level during the irrigation season did not rise to a dangerous position for plant growth. The highest level of ground water was three feet below the soil surface at one location in the experimental area for a period of 10 days during the heavy spring irrigation.

Summary of water application to crops on Snyder plots, Grand Junction, 1954

Crop	Water applied	Consumptive use requirements 1/
	Inches	Inches
Alfalfa..........	37.5	28.3
Corn.............	21.1	17.7
Beets............	45.6	22.2
Barley...........	27.2	13.3
Barley-alfalfa 2/.	36.0	---

1/ Computed by Blaney-Criddle method.
2/ Barley was used as nurse crop for alfalfa.

West

Washington. Columbia Basin fertilizer-irrigation studies. J. S. Robins, C. E. Nelson, and C. E. Domingo, Prosser.

Beet Yields Cut by Early Excess Irrigation; Affected by Nitrogen Rates, Placement

Two experiments with sugar beets were conducted in 1954 in the Columbia Basin to study further the relationships between nitrogen rate and placement and the application of excessive quantities of irrigation water. At each location, three nitrogen rates applied by each of four placement methods were studied under five irrigation treatments. Results from the two locations follow:

Yield of sugar beet roots from five irrigation treatments, two locations, Columbia Basin, 1954

Designation	Irrigation treatment: Excess water	Season applied	Irrigations	Yield per acre
	Inches		Number	Tons
Location 1				
(Ephrata loamy sand)				1/
1	12	---	9	29.2
2	7	---	5	27.7
3	26	---	9	26.5
4	31	---	5	25.1
5	57	---	9	26.0
Location 2				
(Othello fine sandy loam)				2/
1	5	all	6	25.0
2	16	early	9	24.7
3	47	early	9	21.6
4	28	late	8	25.0
5	74	late	8	25.6

1/ Least significant difference at 5% level is 1.3 tons of roots per acre.
2/ Least significant difference at 5% level is 2.1 tons of roots per acre.

It appears that application of excess water will remove sufficient nitrogen to affect the yield if the water is applied early in the season. Later applications appear to have little effect on the current crop.

The effects upon yield of different amounts and methods of applying fertilizer nitrogen are presented in the tables that follow:

Yield of sugar beet roots per acre from three nitrogen fertilizer treatments and no treatment, Columbia Basin, Washington, 1954

Treatment (nitrogen per acre)	Yield: Location 1	Location 2
Pounds	Tons	Tons
0 1/	12.6	16.9
120	23.1	22.9
240	28.0	25.1
360	29.6	25.2
Least significant difference at 0.05 level	1.0	0.9

1/ Check plots not part of experiments.

Yield of sugar beet roots per acre associated with four fertilizer placement methods, Columbia Basin, Washington, 1954

Placement method	Yield	
	Location 1	Location 2
	Tons	Tons
Plowed................	27.4	24.3
Disced................	24.7	24.3
Side-drilled, shallow.	27.5	24.2
Side-drilled, deep....	28.0	24.7
Least significant difference at 0.05 level	1.2	None

1. Of particular interest is the placement effect for location 1.

2. Note the relatively poor performance of the disced application. Similar results were obtained at a third location in the Yakima Valley for a soil with considerably more native nitrogen.

3. At each location a rate-irrigation interaction occurred in the form of poorer response to irrigation treatment at low nitrogen rates.

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Arizona. Irrigation of long staple cotton (American-Egyptian) at the Mesa Experimental Farm in cooperation with the University of Arizona Agricultural Experiment Station. Karl Harris and Leonard J. Erie, Phoenix.

Number of Irrigations of Long Staple Cotton Outranks Other Influences

Pima S-1 cotton was planted in 4-row plots, 275 feet long, replicated four times, and irrigated by the basin irrigation system. The Mesa farm soils are a clay loam, having about 1.8 acre-inches per foot of available water storage capacity. One foot of irrigation water was applied previous to planting and all subsequent irrigations were of 5 acre-inch applications. The two main objectives were (1) to determine the best schedule for irrigating cotton when limited water is available, and (2) to determine the value of a late summer irrigation. A planting date variable under the limited irrigation water schedule was included in the experiment.

Long staple cotton yield from various irrigation practices and two planting dates, Arizona, 1954

Treatments[1]	Planting date	No. of 5-inch irrigations	Irrigation dates	Yield of seed cotton, lbs. per plot[2]
1	4/5	3	6/2, 7/2, 8/3	288
2	4/5	3	7/2, 8/3, 9/1	283
3	4/5	3	6/17, 7/14, 8/19	270
4	4/30	3	7/2, 8/3, 9/1	306
5	4/5	7	5/25, 6/22, 7/8, 7/29, 8/9, 9/9, 9/27	390
6	4/5	6	5/25, 6/22, 7/8, 7/29, 8/19, 9/9	404
7	4/5	5	5/25, 6/22, 7/8, 7/29, 9/1	325

1/ All treatments were given a one acre-foot preplanting irrigation.
2/ Minimum difference between means for significance at 5% level of probability is 43.7 pounds; at 1% level it is 59.9 pounds.

The later-planted cotton, treatment 4, attained the same height as the cotton in treatment 2 by July 1 and as cotton in treatments 1 and 3 by August 1. Heights and yields appeared to be closely related.

Conclusions:

1. Neither time of application nor date of planting influenced yields of seed cotton significantly where three irrigations were applied.

2. Six irrigations (treatment 6) increased yields significantly over three irrigations (treatments 1, 2, 3, and 4), although the yields per acre foot of water were higher with only three irrigations.

3. A late irrigation on September 27 did not influence yields of seed cotton (compare treatments 5 and 6).

4. The increase in yield from treatments 5 and 6 over treatment 7 is highly significant. This is unexpected and may be partly explained by a possible error in the yield figure of one of the replications.

5. Yields from the different plots were closely correlated with the attained plant heights. The average height of the plants from August 1 to final harvest date was consistently greater with treatments 5, 6, and 7 than with treatments 1, 2, 3, 4, and 5.

Oregon. Irrigation studies, Owyhee project. Fred Tileston, Irrigation Engineer, Ontario.

Improved Water Management Practices Increase Irrigation Efficiency

Results of irrigation management studies on the Owyhee Irrigation Project of eastern Oregon, now being prepared for publication, are summarized as follows:

Large areas of this project have soils that are shallow or that contain restrictions in the profile which reduce the usable soil depth and consequently limit the amount of water that can be held. More frequent irrigations are commonly required on shallow soils. This results in larger surface water losses.

A review of water use during the past 14 years for the Owyhee project indicates that about 62 percent of the quantity delivered was wasted.

Runoff losses up to 50 percent were found on some experimental irrigation trials. This was due in considerable measure to the low rate of water intake on these soils.

The type of crop grown influences the water intake rate of a soil. A grass cover was the best crop used experimentally for increasing the intake rate of the soil.

The addition of organic matter resulted in a limited increase in the water intake rate. Manure was somewhat better than crop residue. Reducing the distance between corrugations also was an effective means of increasing the intake rate.

Lateral movement of moisture under row crops was slow on coarse-textured soils as compared to vertical movement. This permitted deep percolation losses of water before the upper soil was moistened. Under grass and legume crops, the lateral movement was as rapid as the vertical movement, and the upper soil was fully wetted before water was lost by deep percolation.

Field irrigation efficiencies vary greatly over this project. On soils with a low water intake rate, the application must be continued for a longer period of time. Where irrigation efficiency is low because of excessive runoff and evaporation, more frequent irrigations of shorter duration would tend to be less wasteful of water.

Field irrigation efficiencies tend to be higher where intake rates are fast than where they are slow. The time required to apply the water can be shortened and runoff wastage reduced. Proper timing and careful water control will reduce deep percolation and surface runoff losses.

The following consumptive use data may help improve irrigation practices and reduce water waste on the Owyhee project.

Seasonal consumptive use requirements of certain crops grown in the Ontario area, Owyhee project (rainfall included during growing season)

Crop	Consumptive use1/
	Inches
Wheat	25.6
Alfalfa	37.7
Barley	18.0
Red clover	31.4
Pasture	34.7
Field corn	23.2

1/ Rainfall during growing season included.

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Idaho. Irrigation methods, Black Canyon investigations near Caldwell, Idaho. Claude H. Pair, Boise.

(1) Water Intake Rates Decline in Six Years of Irrigation

The intake rates on a field that has been sprinkler irrigated for six seasons show a decline from 0.32 to 0.18 acre inch per hour. Intake rates were determined by using the double ring infiltrometer method. Tests were run at the same locations on the field each year in the spring and fall.

For the same six-year period, the average intake rates for soil of the plots surface irrigated by the downslope small furrow, the downslope border, and by the contour border methods decreased from 0.43 to 0.10 acre inch per hour. The accompanying chart shows the average rate obtained each year.

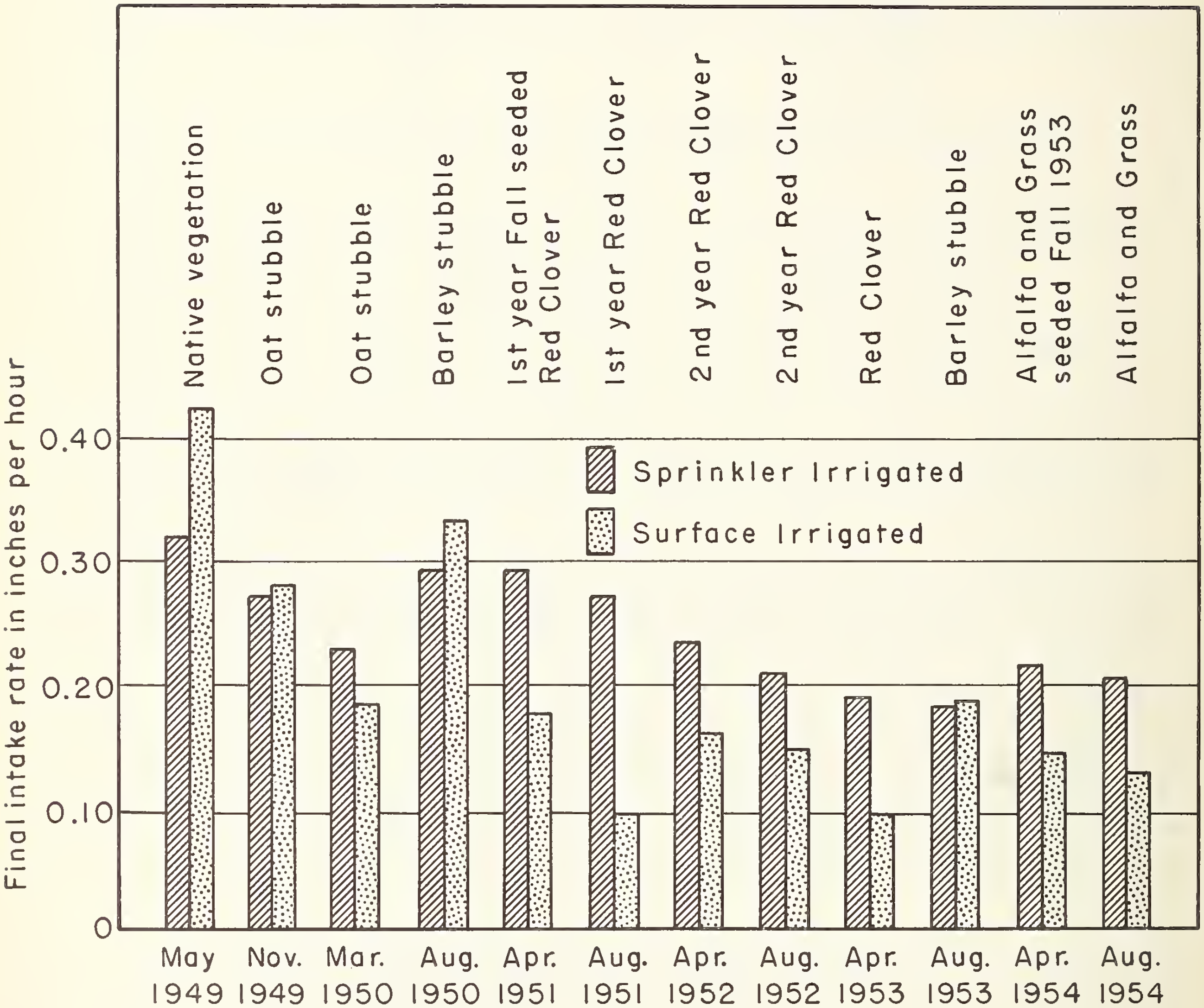
(2) Efficiency of Irrigating Alfalfa and Grass Varies with Irrigation Method

The efficiency of irrigation (percent of applied water held for use) as measured in 1954 on alfalfa and grass plots irrigated by different methods is shown in the following table.

Efficiency of different methods of water application

Irrigation method	Efficiency (proportion of applied water held)
	Percent
Sprinkler	64
Downslope small furrow	44
Downslope border	49
Contour border	73

Water Intake Rate Under Sprinkler and Surface Irrigation
(Mean of 24 ring infiltrometers at 6 locations in 48 hour tests)



California. Replenishment of irrigation water in deep underground aquifers. Leonard Schiff and Eldred S. Bliss, Bakersfield.

(1) Special Treatment Required in Trench or Pit Method of Replenishing Aquifers

In a water-spreading area a trench was cut through a surface soil horizon which overlies a more pervious, sandy layer. Infiltration rates from the trench were lower than expected and decreased with time. It was observed that the trench had become partially clogged with a layer of the finer textured surface soil carried in with the water supply.

Infiltrometer tests were later made on the dry and partially crusted surface of the trench floor: (1) On an undisturbed section; (2) on a disturbed section treated to a depth of 3 inches with soil conditioner (VAMA) at a rate of 0.1 percent; (3) on the sand aquifer after removing the fine textured overwash; (4) on a section previously treated with soil conditioner (VAMA); and (5) on a portion with stratified soil of finer texture.

Tests 2, 3, and 4 showed high infiltration rates. The rates for tests 1 and 5 were much lower.

It is concluded from these tests that to secure and maintain a satisfactory infiltration rate into a subsurface sand aquifer of a water-spreading area by the trench method, either: (a) The clogging, fine textured soil layer washed in over the sand should be removed or (b) a soil stabilizer should be mixed with this fine textured soil layer.--(Schiff)

(2) Gypsum Has Little Effect on Water Infiltration Rate of Small Pond

The infiltration rate from a 0.005-acre pond declined from an initial rate of 2.0 to 0.87 acre feet per day after an operation period of $3\frac{1}{2}$ months. A gypsum solution was then metered into the pond at a rate to maintain the calcium content of the pond water approximating that of water from a nearby well. The pond was operated for an additional 3-weeks' period.

Data secured from this test indicate that the addition of gypsum caused, at best, but a small increase in the infiltration rate. The rate increased from 0.87 acre foot per day when the gypsum was first added to 1.15 acre feet per day one week later. The rate then declined over the additional 2-week test period to approximately that prevailing at the beginning of the test.--(Bliss)

National

Plant Industry Station, Beltsville, Md. Summarization and analysis of runoff and soil loss data from plots and small watersheds. R. E. Uhland, Beltsville.

Results of 63,000 Storms at 29 Locations in 18 States to Be Published

The Eastern and Western Soil and Water Management Sections have under way a joint project to summarize and analyze runoff and soil loss data collected in various parts of the United States during the past 20 years. These data reflect the effects on runoff and erosion of type of soil, land use, cultural operations, utilization of residues, use of fertilizers, soil amendments, and other variables.

Runoff and soil loss data from 29 locations in 18 States are being tabulated by field technicians. These are then forwarded to W. H. Wischmeier at Lafayette, Ind., for coding and placing on IBM cards for analysis. Following the analysis, it is expected that summaries will be published in a series of bulletins.

It is estimated that approximately 63,000 individual storms will be reported and the maximum 5-, 15-, and 30-minute intensities listed, along with the amount and duration of each storm. In addition, all excess storms, that is, those storms which meet the specifications set by the Weather Bureau, will be described in detail so that the type of storms at the many locations may be compared. We estimate that there will be about 3,300 of these storms. According to questionnaire replies recently received, runoff and soil loss data will be reported for 8,235 plot years and 2,285 watershed years.

Measurements are still being continued on 235 plots in the Eastern Section and 135 in the Western Section, also on 14 small watersheds in the Eastern Section and 21 in the Western Section.

Southeast

Florida. Design and maintenance of water control facilities. J. C. Stephens, Fort Lauderdale.

Pensacola Bahia and Kudzu May Be Good Levee Erosion Control Plants

Six plots of one-sixth acre each, representative of the various soil and rock conditions along the Federal flood control levees, were seeded in 1951 with Pensacola Bahia grass. In the spring and summer of 1952 plantings of

tropical kudzu (Pueraria phaseoloides) were made on the stretch of limestone levee between North New River and Hillsboro Canal.

Observations of these plantings in December 1954 showed that both groups of plants were growing despite poor soil and moisture conditions and a very high soil pH.

A very poor stand of the Pensacola Bahia grass was initially obtained, and it has taken over 3 years to spread to the extent that its cover would be termed satisfactory. However, this grass appears to be very hardy under the extremely adverse conditions to which it has been subjected and may prove to be an effective erosion control plant for this type levee in cases where rapid coverage is not an important factor.

The kudzu plantings were also doing satisfactorily where a stand had been initially obtained and have made fair growth during the past year although no special treatment other than a light application of fertilizer in the spring was applied. Blooms and seed pods were in evidence and the seed, while not mature, appeared to be viable. These plantings appear to be more promising at present than one year ago, and kudzu may yet prove to be a suitable erosion control plant in the subtropics where a dense growing cover crop that will not spread into adjacent drainage canals is needed.

Great Plains

Texas. Graded vs. level closed-end terraces, Amarillo Experiment Station (Bushland). C. E. Van Doren, Bushland.

Level Terraces Superior During Dry Years

Crop yields were higher in 1954 on the level closed-end terraces than on graded terraces. This has been true for other dry years in the past. During wet years water sometimes stands too long in the terrace channels and drowns out the crop, reducing yields below those from the graded open-end system.

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Oklahoma. Terraces on wheat land in western Oklahoma. Maurice B. Cox and Harley A. Daniel, Guthrie.

Runoff Water Influenced by Vertical Spacing of Terraces

Moisture conservation research at the Wheatland Conservation Experiment Station, Cherokee, was recently summarized for the period 1942 to 1951 in a manuscript that will soon be published. Some of the results obtained on the effects of terrace interval on water runoff are presented here.

Where the direction of cultivation was on the contour, there was a gradual increase in the percentage of the precipitation lost by runoff as the terrace interval increased from 3 to 10 feet (see table below). There was also a greater loss of water by runoff where the direction of cultivation was with the slope than on the contour. Observations indicate that erosion occurred between terraces during heavy rains on clean tilled land. There was no noticeably erosion on stubble mulched land with terraces having vertical intervals of 6 feet.

Runoff water from terraced land1/ with different vertical intervals, Cherokee, Oklahoma, 1942-51

Direction of cultivation	Vertical interval	Precipitation lost in runoff
	Feet	Percent
With slope	6	13.8
Contour	3	9.0
Contour	6	11.7
Contour	8	13.0
Contour	10	15.9
Contour	12	15.8

1/ Land slope ranging from 1.7 to 3.0 percent.

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Kansas. Investigations of the mechanics of wind erosion. W. S. Chepil, Manhattan.

Silt Helps Soil Resist Wind Erosion but Cuts Size of Water-stable Aggregates

A study was recently completed to determine the contribution of the sand, silt and clay separates to soil structure and the erodibility of the soil by wind. A manuscript presenting the detailed study has been prepared for publication. Some of the results are summarized here.

Where soil was composed of only one separate, the greatest degree of cloddiness and resistance to wind erosion was obtained with the fine silt separate ranging from 0.005 to 0.01 mm. in diameter. An extremely low degree of cloddiness and high erodibility was obtained with the fine sand separate. However, very coarse sand (1 to 2 mm.) resisted wind erosion to a marked degree even with a high wind velocity. A moderate degree of cloddiness and erodibility was obtained with the clay separate.

In soils composed of two or more separates, an increase in silt content increased cloddiness and mechanical stability of clods and decreased erodibility by wind. In contrast, an increase in silt content resulted in a greater dispersion of soil in water as indicated by an increase in water-stable particles less than 0.02 mm. in diameter.

An increase in clay separate up to 20 percent in a mixture of silt and clay and up to 100 percent in a mixture of sand and clay increased soil cloddiness and reduced erodibility by wind. Clay in amounts greater than 20 percent mixed with silt caused the formation of a substantial proportion of small granules highly erodible by wind. In all cases, an increase in fine sand in mixtures with either clay or silt separates resulted in an increase in erodibility by wind.

These results contribute to an understanding of the role soil texture plays in determining the erodibility of field soils by wind.

SOIL FERTILITY

Southeast

Alabama. Water use by Crops in Relation to Soil Nitrogen Status.
H. A. Weaver and R. W. Pearson, Auburn.

Nitrogen Fertilization Increases Efficiency of Water Use by Sudan Grass

Evapotranspiration rates by Sudan grass grown in Lloyd clay at two soil moisture, three plant density, and two nitrogen levels were observed for one month during which time the plants grew from a height of about 2 inches to maturity for hay.

Evapotranspiration rate was affected very little by nitrogen level, but it was influenced appreciably by plant population level. Water use efficiency, however, was greatly increased by the application of nitrogen, which produced a relatively heavy growth of grass without appreciable change in total evapotranspiration. An over-all linear increase in efficiency with population increase also occurred.

Evapotranspiration rates were appreciably greater for all treatments and periods at the high soil moisture level than at the low level.

Minimum evapotranspiration for all treatments occurred during the first week when water availability was relatively low for both soil moisture levels, climatic factors favored low evaporation, and the plants were small. Maximum rates occurred during the second and third weeks, and a general decline took place in the fourth week when the plants entered the early dough stage.

Oklahoma. Fertilization of winter wheat. Harold V. Eck, Stillwater.

Five Winter Wheat Varieties Respond Similarly to Fertilizers in Oklahoma

One season's results are available from an experiment designed to study the comparative reactions of five varieties of hard red winter wheat to seven different fertilizer treatments. The fertilizer treatments had no significant effect on yield of grain, yield of straw, or phosphorus content of grain. The protein content of the grain and the nitrogen content of the straw were increased significantly with nitrogen fertilizer treatments.

There was a significant difference among varieties in yield of grain, yield of straw, phosphorus content of grain, protein content of grain, and nitrogen content of straw. There was, however, no significant variety-fertilizer interaction in any of these measures. If this holds true in future seasons, it can be assumed that although these varieties are different in many respects, they are alike in their response to fertilizer.

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Montana. Varietal response of winter wheat to fertilizer, Central Montana Branch Station. R. M. Williams and J. L. Krall, Moccasin.

Four Winter Wheat Varieties Respond Similarly to Fertilizers in Montana

The primary objectives of the experiment were to determine (1) the effect of phosphorus fertilizer, placed with the seed, on the spring survival of winter wheat; (2) the relative amounts of tillering associated with the use of nitrogen and phosphorus and a combination of the two; (3) the ultimate yields, both of grain and straw, of several fertilized varieties; (4) effect of fertilizers on protein content; and (5) any interaction among the varieties due to their fertilizer response.

The data obtained during the three years (1952-54) are summarized in the table that follows. Due to relative mild winters during these trials only a small amount of winter killing occurred; thus, no data could be obtained concerning the effects of fertilizer on spring survival. However, from visual observations those plots receiving phosphorus, either alone or in combination with nitrogen, appeared to have healthier and stronger plants than those plots that received nitrogen alone or no fertilizer.

The varieties responded nearly alike to fertilizer treatments. Those plots receiving phosphorus, alone or with nitrogen, yielded more grain than those receiving nitrogen alone or no fertilizer. Nitrogen-phosphorus and phosphorus plots yielded approximately the same while nitrogen and the check plots yielded in the same manner.

The fertilizer treatments increased the production of straw relatively more than the production of grain. The nitrogen-phosphorus plots averaged the highest straw-grain ratio with the nitrogen plots next.

The application of phosphorus either with nitrogen or alone increased the number of tillers. Nitrogen alone increased tillering only slightly in comparison to the phosphorus.

Test weights of wheat from plots fertilized with nitrogen, alone or in combination with phosphorus, were approximately 1 pound per bushel lower than those from check plots. Phosphorus alone brought test weights the same as those for the check.

Protein content was increased about 2 percent when nitrogen was part of the fertilizer, used either alone or in combination with phosphorus. Phosphorus alone resulted in a similar protein content to that of the check.

Summarizing the three years' results: Varieties used in this experiment reacted approximately the same to the different fertilizer treatments not only in yield but in the straw-grain ratios, tillers produced, test weight and protein content.

Responses of four winter wheat varieties to fertilizers (grain yield, straw-grain ratio, tillers, test weight, protein content), Moccasin, Montana, 1952-54 averages

Variety	Fertilizer 1/	Grain yield per acre	Straw per pound of grain	Tillers per 3 ft.	Test weight per bu.	Protein content
		Bushels	Pounds	Number	Pounds	Percent
Yogo	NP	27.8	2.84	159	60.4	14.2
	N	25.2	2.71	140	59.7	14.1
	P	27.1	2.69	145	61.0	12.1
	Check	25.3	2.38	132	61.0	11.9
Commanche	NP	24.6	2.97	171	58.6	15.8
	N	23.8	2.78	128	59.0	15.7
	P	26.1	2.70	135	60.0	13.1
	Check	22.4	2.50	115	60.7	13.1
Karmont	NP	30.6	2.65	173	59.4	14.4
	N	26.2	2.52	148	59.9	14.3
	P	28.4	2.45	164	60.3	11.8
	Check	25.9	2.31	131	60.6	12.2
Wasatch	NP	28.2	2.79	140	59.1	14.4
	N	25.3	2.71	116	59.3	14.9
	P	28.7	2.68	132	60.3	12.5
	Check	25.3	2.59	109	60.2	12.7
Average of all varieties	NP	27.8	2.81	161	59.0	14.7
	N	25.1	2.68	133	59.4	14.7
	P	27.6	2.63	144	60.1	12.4
	Check	24.7	2.46	122	60.2	12.5

1/ Rates of fertilizer: NP = 30 pounds P_2O_5 and 30 pounds N per acre; N = 30 pounds N per acre; P = 30 pounds P_2O_5 per acre.

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Texas. Cotton fertilizer test, Blackland Experiment Station. E. D. Cook and W. R. Parmer, Temple.

Nitrogen and Phosphorus Fertilizers Together Increase Cotton Yield

Four cotton fertilizer tests were conducted off the Blackland Station and one on the Station in the years 1952-54. The tests off the station were at the Stiles farm one mile east of Thrall, on Bell and Houston black clay;

Pricemeyer farm 2 miles west of Thrall, on Bell clay; and Senkel farm 6 miles south of Rogers in the Little River bottom, under irrigation. The test at the Blackland Station was on Houston black clay. The tests have been conducted on the Stiles farm, Senkel farm, and on the station for 2 years and on the Pricemeyer farm for three years.

Neither nitrogen or phosphorus alone was as effective in increasing seed cotton yields as when they were used together. In fact, nitrogen alone had a tendency to decrease yields. There was not a significant difference in yields between the 30 and 60 pounds of P_2O_5 used alone in the upland tests or the 60 and 120 pounds in 1953 or the 45 and 90 pounds used in 1954 in the irrigated test. The lighter rates of nitrogen with phosphorus were as effective in increasing cotton yields on the upland as the higher rates of nitrogen, probably because of the dry weather and the amount of available nitrogen in the soil. Potash added to nitrogen and phosphorus had a tendency to decrease yields.

In the check plots, available nitrogen tends to be low in March, April, and May. It increases and reaches its peak in June and July and starts decreasing in August and September. Up to now there is not a definite relationship between seed cotton yields and available nitrogen. However, it is noted that there is more available nitrogen in Bell clay when cotton follows cotton than when cotton follows corn and that there is more nitrogen in the Houston black clay when cotton follows cotton than when it follows grain sorghum.

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New Mexico. Tucumcari Irrigation Project. Work directed from Northeastern Substation. Ralph E. Campbell, Tucumcari.

Nitrogen Fertilizer Needed for High Yields of Castor Beans

Two fertilizer experiments with castor beans were conducted at two locations in 1953. A similar trial was run at a third location in 1954. Fertilizers were band placed 3 inches deep and 2 to 4 inches to the side of the bean row at planting time. Beans were harvested in the latter part of October both years. Two irrigations were applied to each of the 1953 experiments. A marked growth response to nitrogen was evident. The 1954 experiment received no irrigation, the stand was thin, and yields were low.

Yields, in pounds of threshed beans per acre from the three experiments, are presented in the following table.

Castor bean yields per acre obtained from variously treated plots in three fertilizer experiments on the Tucumcari Irrigation Project, 1953 and 1954

Fertilizer treatment		1953 yields per acre		1954 yields per acre
N	P_2O_5	Yocum location	Clark location	Morton location
Pounds	Pounds	Pounds	Pounds	Pounds
0	0	1489	1553	679
80	0	1867	1925	880
160	0	1993	2046	977
0	40	1418	1800	734
80	40	1858	2183	692
160	40	2152	2278	930
0	80	1782	1813	745
80	80	1941	2216	765
160	80	2072	2277	951
Least significant difference at 0.05 level		175	195	228

A statistically significant response to phosphate fertilizer was shown in only one of the three experiments, although distinct trends were shown in favor of its use. From a practical standpoint, an application of 40 pounds per acre of P_2O_5 would supply the needs of a castor bean crop.

On the other hand, marked response to nitrogen fertilization was shown at all three locations. The 160-pound nitrogen application produced the highest yields at all locations, but these yields were not quite significantly higher than those produced from the 80-pound rate on the Clark and Yocum farms.

The results from these experiments indicate that the production of a high yielding crop of castor beans on the Tucumcari Irrigation Project requires substantial amounts of nitrogen fertilizer. Between 80 and 160 pounds are required to produce maximum yields.

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New Mexico. Fertilization of irrigated crops. Ross W. Leamer, State College.

Heavy Initial Phosphorus Application Best for Alfalfa

Alfalfa responds to phosphorus fertilization in eastern New Mexico.

A group of cooperative fertilizer experiments was started in 1952 to determine the amount of phosphorus required in the various irrigated areas.

Most of these experiments compared initial applications of 0, 60, 120, 240, and 480 pounds of P_2O_5 per acre. The fertilizers were broadcast on the surface of established stands in cooperating farmers' fields. Yields were taken as long as the field was in alfalfa. Three years' results from some of these experiments show that the highest yields are obtained from the heaviest fertilizer application. The most profitable rate as far as hay production is concerned is 60 to 80 pounds of P_2O_5 per acre per year the alfalfa is to be harvested for hay. Studies of the carry-over effects on the following crops have not been completed.

Treatments in one experiment south of Hobbs, N. Mex., were changed in 1954 to compare split applications of fertilizer with the initial applications. These treatments were designed so that three treatments each received a total of 120 pounds of P_2O_5 per acre, two treatments 240 pounds, and one 480 pounds in the 3-year period. The time of application and the yields obtained are given in the table below.

Alfalfa hay yields in relation to the application of phosphorus fertilizer. Hobbs, New Mexico, 1952-54

Treatment no.	P_2O_5 applied per acre in 1/		Yield of alfalfa hay 2/				
			Per acre				Per pound of P_2O_5 applied
	1952	1954	1952 (4 cuttings)	1953 (3 cuttings)	1954 (3 cuttings)	Total (10 cuttings)	
	Pounds	Pounds	Tons	Tons	Tons	Tons	Pounds
1	0	120	3.79	1.98	2.56	8.33	139
2	60	60	4.58	2.94	2.50	10.02	167
3	120	0	5.30	4.21	1.85	11.36	189
4	240	0	5.67	5.35	2.12	13.14	110
5	480	0	5.58	5.55	2.33	13.46	56
6	120 3/	120	4.65	3.43	2.66	10.74	90

1/ No phosphate applied in 1953.
2/ Mean of 6 replicates.
3/ Potash applied with phosphate in 1952.

Treble superphosphate was broadcast on the surface in the early spring of both years that fertilizer was applied. The 1953 yields on treatment 1, the unfertilized plots, were so low they were hardly worth harvesting. The 1954 fertilizer was applied on March 6, and the yields taken on May 6 were higher from these plots than from treatments 2 or 3 (described in table), each of which received the same total amount of P_2O_5. The yields from treatment 1 continued to be higher through 1954 than the other two treatments receiving 120 pounds of P_2O_5, but the higher yields in 1952 and 1953 from treatments 2 and 3 more than offset the increase from treatment 1 in 1954.

The efficiency of the various treatments can be determined by calculating the pounds of hay produced per pounds of P_2O_5. This comparison shows the heavy initial application of the amount needed is the most efficient. For the three-year period, the 120 pounds of P_2O_5 applied in 1952 was the most efficient of all the treatments. On this same basis, a comparison of the two treatments receiving 240 pounds of P_2O_5 also shows the initial heavy application to be superior to the split application.

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Nebraska. To determine the effect of phosphorus fertilizer on the yield and composition of alfalfa grown under two systems of soil management. Field work, Scotts Bluff Experiment Station; laboratory work, Lincoln. Fred E. Koehler, Lincoln.

Phosphate Response by Alfalfa Influenced by Past Manurial Practice

A study was begun in 1952 at the Scotts Bluff Experiment Station to evaluate the effects of previous manurial treatment on the ability of Tripp very fine sandy loam to produce alfalfa. Two 6-year rotations were used, one of which had received 12 tons of manure per acre per rotation cycle since 1912. An experiment using 5 rates of phosphorus fertilization (0, 40, 80, 160, and 320 pounds of P_2O_5 per acre) was set up in 1953 on alfalfa in each of these two rotations. In 1953 all rates of phosphorus application resulted in a significant increase in yield on the non-manured plots but not on the manured plots. In 1954, yields were measured on these same plots to study the residual effects of the 1953 fertilizer application. Concentrations of nitrogen and phosphorus in this alfalfa were also determined.

The yields of alfalfa hay are shown in the table that follows. Where manure had not been used, the use of phosphorus fertilizer in 1953 caused significant yield increases in 1954. There were some yield increases caused by fertilizer application where manure had been used but these were not statistically significant.

Yields of alfalfa obtained with phosphorus fertilizer on previously manured and non-manured plots, Scotts Bluff, Nebraska, 1954

Treatment 1/ (P_2O_5 per acre)	Yield per acre from--							
	Rotation 63 (non-manured)				Rotation 63 B (manured)			
	1 cutting	2 cuttings	3 cuttings	Total	1 cutting	2 cuttings	3 cuttings	Total
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
0	2750	4580	2260	9590	3450	4480	2560	10490
40	2730	5080	2310	10120	3390	4520	2450	10360
80	3000	4750	2310	10060	3550	4610	2710	10870
160	3070	4730	2380	10180	3470	4720	2670	10860
320	3330	5070	2490	10890	3640	4700	2580	10920

1/ Applied in 1953.

The concentrations of nitrogen and phosphorus in the hay are shown in the next table. In general, the use of phosphorus fertilizer or manure had little effect on the concentration of nitrogen in the alfalfa.

Alfalfa: Nitrogen and phosphorus concentrations in hay grown on previously manured and non-manured plots, all treated in 1953 with phosphorus fertilizer, Scotts Bluff, Neb., 1954

Treatment 1/ (P_2O_5 per acre)	Concentrations in hay from--					
	Rotation 63 (non-manured)			Rotation 63 B (manured)		
	1 cutting	2 cuttings	3 cuttings	1 cutting	2 cuttings	3 cuttings
Pounds						
	Percent nitrogen					
0	2.53	2.75	3.09	2.50	2.94	2.96
40	2.56	2.78	2.96	2.43	2.92	3.01
80	2.47	2.83	3.01	2.58	2.91	2.96
160	2.50	2.86	3.15	2.55	3.03	3.04
320	2.45	2.90	3.01	2.42	2.90	2.81
	Percent phosphorus					
0	0.14	0.20	0.21	0.17	0.23	0.23
40	0.15	0.21	0.21	0.17	0.25	0.24
80	0.16	0.23	0.23	0.19	0.26	0.24
160	0.18	0.26	0.26	0.21	0.27	0.26
320	0.19	0.28	0.28	0.22	0.27	0.26

1/ Applied in 1953.

Concentrations of phosphorus in the hay were greatly increased where fertilizer phosphorus was applied. There was a much greater increase in phosphorus concentration in the hay from the non-manured plots than in that from the manured plots. Where fertilizer was not used, the hay from the manured plots had a higher phosphorus concentration than that from the non-manured plots. However, this difference decreased with increasing rates of phosphorus fertilization until there was practically no difference at the highest rate used.

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Nebraska. Effect of phosphorus and nitrogen fertilizer on stand establishment of alfalfa and yield of oats, Scotts Bluff Experiment Station, R. R. Allmaras, Soil Scientist, Mitchell.

Nitrogen Fertilizer Unfavorable to the Establishment of Alfalfa Stands

Three rates of nitrogen, 0, 40, and 80 pounds per acre, with each of four rates of phosphorus, 0, 40, 80, and 160 pounds per acre were used in these studies.

Stand establishment measurements of alfalfa were made August 14 and September 2, 1953, and again on April 16, 1954. The results show that under conditions of this experiment nitrogen fertilizer applications of 40 pounds per acre were detrimental to the establishment of a good stand of alfalfa. Phosphorus applications had no effect on stand establishment.

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Nebraska. Effect of available soil moisture and nitrogen fertility on yield and chemical composition of winter wheat under continuous cropping, North Platte Experiment Station. R. E. Ramig and F. E. Koehler, North Platte.

Effect of Nitrogen on Wheat Yield Related to Soil Moisture Before Planting Time

As a basis for the better understanding of the nitrogen fertilizer requirements for continuous winter wheat production in the semi-arid Great Plains, a study was initiated in the fall of 1953 to determine the relationship between nitrogen treatments and available soil moisture at planting time. This experiment is on Holdrege very fine sandy loam with a pH of 6.1 and a total nitrogen percentage in the surface soil of 0.091.

Yield responses to supplemental moisture prior to planting time and to nitrogen fertilizer were great. An application of 80 pounds of nitrogen did not give an increase in yield over 40 pounds at any moisture level. When applied in the spring where the soil had been wet down but 2 feet, a yield reduction for the 80-pound rate occurred. In all instances where additional moisture had been supplied, 40 pounds of nitrogen gave a higher yield than the 20-pound rate, which significantly increased yields above the non-treated checks. Although not statistically significant, a yield increase of 2.4 bushels per acre was obtained from a winter application of 20 pounds of nitrogen where no supplemental moisture was added in a year when only 8.87 inches of precipitation occurred in the October-June period.

There was a trend toward higher yields from winter broadcast than from spring nitrogen applications. When only 20 pounds of nitrogen was applied, no increase in yield resulted where the soil had been wet 6 feet as compared to 4 feet. However, the 40- and 80-pound rates of nitrogen caused further increases in yield where the soil had been wet to a depth of 6 feet.

The protein content of the grain decreased as available moisture increased. Applications of nitrogen fertilizer increased the protein content of the wheat correspondingly more as the rates of nitrogen fertilizer were increased. Spring applications of nitrogen increased the protein more than equivalent winter applications.

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Nebraska. Runoff, erosion and infiltration experiments. F. L. Duley, Lincoln.

Nitrogen Fertilizer Valuable for Corn, Oats Production on Sandy Land

Corn on the sandy land farm gave every evidence of crop failure during mid-July. However, weather conditions turned more favorable and relatively good yields were obtained on most of the plots. Some parts of the field gave about as good yields as have been obtained during any of the years that the tests have been conducted.

Results continue to show the very great importance of a copious supply of nitrogen for high yields of the grain crops. Nitrogen may be supplied either by fertilizers or through the growing of legume crops.

In 1954 the application of 40 pounds of nitrogen per acre increased the protein content of oats grown on subtilled land by 1.1 percent and on plowed land by 2.2 percent. The protein content of oats grown on the untreated land was slightly higher where subtilled than where plowed but lower than where nitrogen had been applied. It was shown in the first Quarterly Report that the yield of oats was increased approximately 30 bushels per acre by the use of nitrogen. Since the protein percentage was also increased, the total results were very much in favor of the use of nitrogen.

Results with wheat, however, were different. Although there was an increase of slightly over 1 percent in the protein content, the wheat yield was changed very little by the nitrogen application. This may have been due to the fertilizer being put on a little too late for wheat. Or it may have been due to the fact that there was a poor crop that could not use nitrogen any more rapidly than the soil could supply it. (Much of the wheat did not germinate in the fall but came up in the spring.)

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Nebraska. Fertilizers for crops following irrigated bromegrass pasture, Scotts Bluff Experiment Station. F. V. Pumphrey, R. R. Allmaras, and Lionel Harris, Mitchell.

After Irrigated Bromegrass Pasture, Crops Respond Little to Fertilizer

Commercial fertilizers produced only moderate increases in the yields of successive crops of potatoes, corn, sugar beets, and corn, after bromegrass pasture plowed in 1949 for the potato crop. The experiment was enlarged to include another field of bromegrass plowed in 1953.

Potatoes were planted on both fields in 1953, and yields were not affected greatly by fertilizers applied.

In 1954 the fields were planted to sugar beets. Plots treated with nitrogen fertilizer on the field plowed from sod in 1949 produced higher

yields of beet roots than untreated plots, but the beets contained less sugar. There was no significant difference in the acre yields of sugar. Fertilizer applications on the field plowed from sod in 1953 did not influence yields of roots or total sugar significantly. Fertilizer treatments applied in 1954 were as follows: Check, 40-0-0, 80-0-0, 0-40-0, 40-40-0, 80-40-0, and 80-40-40.

The structure of the soil after plowing the bromegrass sod appears to be excellent. A determination of the length of time it remains so is one of the objectives of this study.

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Wyoming. Improving productivity of Wyoming soils. William F. Spencer, Laramie.

Nitrogen Fertilization Increases Pasture Yields but Decreases Legume Stand

In this experiment, various rates of nitrogen and phosphate were applied to a native irrigated pasture in Sheridan County. The following table gives the rates of fertilizer applied and the results obtained in terms of yield and percent forage composition.

Yield and percent forage composition of irrigated pasture due to various fertilizer treatments, Sheridan County, Wyo., 1954

Treatments		Yield per acre1/	Forage composition2/		
Nitrogen per acre	P_2O_5 per acre		Grass	Clover	Dandelion
Pounds	Pounds	Tons	Percent	Percent	Percent
0	0	0.81	38	35	7
26.7	0	1.50	58	10	10
53.4	0	1.83	64	5	20
106.8	0	2.32	58	4	30
0	100	1.11	38	36	12
0	200	1.22	33	44	8
26.7	100	1.46	58	12	16
26.7	200	1.84	47	19	16
53.4	100	2.06	61	4	24
53.4	200	2.16	53	6	20
106.8	100	2.36	68	3	19
106.8	200	2.61	59	2	35
Least significant difference at 0.05 level		0.29			
Least significant difference at 0.01 level		0.38			

1/ Average of 4 plots for one cutting.
2/ Average of 4 plots by quadrat method.

Yields of hay were increased markedly by applications of nitrogen fertilizer but only slightly by phosphate.

Percentage clover (mainly alsike) in the mixture decreased as the nitrogen application was increased. Phosphate applications had little effect on the relative amounts of grasses and legumes in the pasture mixture.

West

California. Effect of soil moisture and nitrogen on the production of dry matter and nitrogen uptake by sugar beets, Southwestern Irrigation Field Station. A. J. MacKenzie, K. R. Stockinger, and B. A. Krantz, Brawley.

Large Amounts of Nitrogen Are Taken up by the Sugar Beet Plant

In Quarterly Report No. 2, the results of an experiment involving soil moisture and nitrogen variables on yield of sugar beets were reported. In connection with this experiment, a study was made of the effect of these variables on the dry matter production and nitrogen uptake by the sugar beets. Periodic sampling of the beets, both tops and roots, were taken at 80 days, 120 days, and 150 days after planting and at 20-day intervals thereafter until the end of the growing season. Samples were obtained from all of the nitrogen rates for the M1 (0.3 atmosphere) moisture treatment and at the rate of 320 pounds of nitrogen per acre for the M2 (0.7 atmosphere), M3 (2 atmosphere) and M4 (6 atmosphere) moisture treatments.

The dry matter production and nitrogen uptake at the end of the season, June 29, 267 days after planting, are given in the table that follows.

Dry matter and nitrogen content of sugar beets grown under various moisture-nitrogen treatments, Brawley, Calif.

Treatment		Dry matter content per acre[1]			Nitrogen content per acre		
Number	Nitrogen per acre	Tops	Roots	Total	Tops	Roots	Total
	Pounds	Tons	Tons	Tons	Pounds	Pounds	Pounds
M1	0	2.80	5.07	7.87	120	116	236
M1	80	3.28	5.88	9.16	124	85	209
M1	160	4.28	6.33	10.61	204	136	340
M1	320	5.28	6.78	12.06	267	162	429
M2	320	5.12	5.97	11.09	268	155	423
M3	320	4.58	5.68	10.26	210	164	374
M4	320	4.76	5.75	10.51	236	162	398

1/ Oven dry basis.

The results are summarized as follows:

1. The greatest amount of dry matter (oven-dry basis), over 12 tons per acre, was produced by the "wet-high nitrogen" treatment.

2. The same treatment resulted in the highest nitrogen uptake, 429 pounds per acre.

3. Compared with the no-nitrogen treatment, the "high" nitrogen level, 320 pounds of nitrogen per acre, brought an increase of over 4 tons per acre in dry matter and 190 pounds per acre in the uptake of nitrogen.

4. Reductions in soil moisture lowered both the yield of dry matter and the uptake of nitrogen. These reductions, however, were small and may not be significant.

5. Slightly less than half of the dry matter was produced as tops. As nitrogen applications were increased, the top-root ratio increased. Reductions in soil moisture did not affect this ratio.

6. This study shows that large amounts of dry matter are produced by a winter-grown sugar beet crop in this area.

7. The results emphasize the high amounts of nitrogen used in growing a crop of beets yielding 25 to 30 tons of roots (field moisture content) per acre.

8. Such a beet crop could be expected to reduce the nitrogen fertility of a field up to 160 pounds of nitrogen per acre by removal of the roots alone. Similarly, if the tops are removed from the field, an additional 200 to 250 pounds of nitrogen per acre would be lost.

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Oregon. Effects of rate and source of nitrogenous fertilizer on winter wheat yields, Pendleton Branch Experiment Station. C. J. Gerard and M. M. Oveson, Pendleton.

Most Nitrogen Fertilizers Increase Winter Wheat Yields to Similar Degree

The influence of eight different sources of nitrogenous fertilizers at four different rates of application on yields of winter wheat was determined at the Pendleton Branch Experiment Station in 1954. Wheat was planted in late October of 1953 and harvested on August 12 and 13, 1954. It was grown on Walla Walla silt loam.

Average yields of Elmar winter wheat from different rates and sources of nitrogenous fertilizers1/, Pendleton, Ore., 1954

Source of nitrogen2/	Yield per acre from--				
		Nitrogen applications per acre			
	0	20 lbs. N	40 lbs. N	60 lbs. N	80 lbs. N
	Bushels	Bushels	Bushels	Bushels	Bushels
Check	33.4				
Anhydrous ammonia		41.7	47.6	48.5	47.5
Liquid ammonia (aqua)3/		---	51.2	51.4	51.8
Ammonium sulfate		41.8	44.5	51.7	45.8
Ammonium nitrate		41.3	48.9	46.5	44.3
Calcium nitrate		42.7	45.2	50.5	49.7
Calcium cyanamid		34.6	41.0	47.3	50.6
Combination4/		40.0	45.6	51.5	48.5
Urea		39.3	45.4	49.9	49.1
Average	33.4	40.2 5/	46.2 5/	49.7 5/	48.4 5/

1/ 3 replications.
2/ Yield differences due to source of N were not statistically significant.
3/ The 20# N/A liquid ammonia (aqua) treatment was not carried out due to lack of proper equipment.
4/ 50% NH_4NO_3, 25% urea and 25% $CaCN_2$.
5/ LSD (1% level) among mean yields resulting from various rates of nitrogen application is 2.7 bushels per acre. (LSD--5% level--among mean yields resulting from various rates of nitrogen of a given source is 5.6 bushels per acre.)

Conclusions:

1. An analysis of the results reveals no significant difference in yield between the sources of nitrogenous fertilizers except for calcium cyanamid, which produced significantly lower yields than the other sources at rates of 20 and 40 pounds of nitrogen per acre.

2. Nitrogen treatments at the rates of 20, 40, 60, and 80 pounds per acre increased yields over the treatment which received no nitrogen by amounts which were statistically significant at the 1 percent level.

3. Based on this study, the most economical rate for the farmers in the locality would probably be 40 pounds of nitrogen per acre.

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Oregon. Fertilization of wheat in Columbia Basin. Albert S. Hunter, Corvallis.

<u>Nitrogen That Increases Yield of Soft White Wheat Ups Test Weight, Protein</u>

Yield data from 48 experiments on winter wheat in the Columbia Basin counties of Oregon in 1953-54 were reported last quarter.

Statistical analyses of test weight data from these experiments have recently been completed. Test weights were determined on individual plots on 46 farms. On 2 farms, the determination was made on composite samples.

Fall-applied nitrogen significantly increased test weights on 31 farms, decreased them on 2 farms, and had no significant effect on 13 farms. Spring-applied nitrogen increased test weights on 31 farms, decreased them on 5 farms, and was without significant effect on 10 farms.

Comparison of yield and test weight data reveals that the decreases in test weights occurred only on farms where nitrogen decreased yields or had no significant effect on yields. Among the 13 farms on which test weights were not affected significantly by nitrogen, there were 4 farms on which yields were not significantly influenced by nitrogen and one farm on which nitrogen decreased yields. In general, test weight and yield associated with increases in nitrogen occurred on fields having shallow soils. The soil was deeper than 2½ feet on only two of the fields where decreases occurred.

Protein analyses have been made on the wheat samples from 40 farms; samples from a total of 8 winter wheat experiments remain to be analyzed. Both spring and fall applications of nitrogen significantly increased protein content on every farm. There were 10 farms on which, without nitrogen, the protein content of the grain was less than 6 percent; on 19 farms the protein content, without nitrogen, was less than 7 percent.

With one exception, all wheat was of soft white winter varieties. Turkey red hard winter wheat was grown on one farm. The protein content of the hard red winter wheat, without nitrogen, was low (6.76 percent) and the rate of increase in protein with increased nitrogen was no greater than that for the soft wheats.

It is understood that for satisfactory baking quality, the protein content of the soft white winter wheats should be between 8 and 10 percent. Protein contents above approximately 10 percent are objectionable in pastry wheats. Data from the 40 experiments for which protein analyses are available indicate that a great many farmers of the Columbia Basin in Oregon should use nitrogen fertilizers in seasons like that of 1953-54 in order to bring the protein content of their wheat up to satisfactorily high levels for pastry uses.

The theory has been held by some that nitrogen fertilizers applied to winter wheat in the spring would, in comparison with the same fertilizer applied in the fall, produce relatively less vegetative growth but higher protein content of grain. The present data do not clearly support that view. Of the 40 farms, there were 17 where spring-applied nitrogen produced significantly higher protein contents than fall applications; 12 where fall applications produced the higher protein contents; and 12 where time of application was without effect.

Summarizing these additional data:

1. In general, during the 1953-54 season the protein content of the soft white wheats grown in these experiments rose to objectionably high levels only after nitrogen had ceased to increase yields significantly.

2. On many Oregon wheat farms in 1953-54 the protein content of the wheat was objectionably low where no nitrogen was applied as fertilizer.

3. In general, test weights of wheat increased where yields were increased by nitrogen. Test weights were decreased by nitrogen only on shallow soils, where yield decreases occurred or where the effects of nitrogen on yield were not significant.

4. The protein content of hard red winter or bread wheat was not significantly different from that of soft white winter or pastry wheat grown with the same rates of nitrogen.

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Oregon. Fertilizer trials on various crops. Carl A. Larson and James A. Burr, Hermiston.

(1) Irrigated Corn Responds to Fertilizer

Five off-station fertilizer trials with corn were undertaken during 1954.

1. The only significant response on three of the farms resulted from the application of nitrogen.

2. A significant response was shown to phosphorus on one farm.

3. Single fertilizer applications resulted in a somewhat better yield than applications that were split.

4. Yields per acre averaged: From check plots 49.6 bushels; from the split application of 200-0-0, 111.5 bushels; from 200-100-0 split, 118.6 bushels; and from 200-100-0 single application, 124.8 bushels.

(2) Nitrogen Fertilizer Increases Yield, Protein Content of Wheat at Hermiston

The protein content of wheat produced in 1953 on the fertility plots at the Hermiston station has been determined.

Comments:

1. The protein content of the wheat increased significantly with increases in the amount of nitrogen applied.

2. As in the off-station wheat fertility trials reported elsewhere in this report, the protein content of soft wheat was not increased objectionably for pastry use within the range of nitrogen applications which gave significant increases in yield.

3. The effect upon yield of nitrogen applications at rates up to amounts 80 pounds per acre was highly significant.

4. The application of phosphorus and potassium had no apparent effect upon wheat yields under the conditions of these trials.

(3) Alfalfa on New Field Respondsto Fertilizer

Fertilizer trials on two fields of alfalfa were initiated in 1954. One was on newly-cropped alfalfa land and the other on an old alfalfa sod. The variables included four rates of phosphorus, three rates of sulfur (gypsum), and one rate of boron.

Results:

1. A significant difference in yield of hay was obtained between the check and fertilized plots on the new alfalfa field, but no response to the treatments resulted from applications to the old alfalfa.

2. The phosphorus content of the alfalfa produced from the new alfalfa plots was increased from .173 percent for the 0-0-0 (P-gyp-B) plots to .212 percent for the 150-0-0 and to .218 percent for the 150-400-0 plots treatment.

(4) Nitrogen Is Only Fertilizer Increasing Pasture Yields in Trials

Fertilizer treatments applied to two off-station pastures in 1953 were repeated in 1954 with some modifications.

Comments on season's results:

1. An analysis of the yield data shows that the application of nitrogen contributes the only real increase in yield of forage from this pasture experiment.

2. Yields of air dry forage per acre were increased from 2.40 tons per acre with the application of 0-100-0 to 3.69 tons per acre with 200-100-0 and to 4.29 tons per acre with 300-100-0.

3. There appeared to be no advantage of a split over a single application of the fertilizer material.

Southeast

Georgia. Legumes and grasses in soil management. B. H. Hendrickson, W. E. Adams, and J. R. Carreker, Watkinsville.

New Grass-Legume Research for the Southern Piedmont Is Started

Several new experiments are being started at the Southern Piedmont Conservation Experiment Station in order to provide more information on grass-legume management and on the value of grasses and legumes in cropping systems. These experiments are conducted on Cecil soils on sites typical of much of the southern Piedmont.

One of these experiments is a study of seeding methods for grass-legume mixtures. In this experiment the legumes and grasses are seeded broadcast, in 10-inch rows and in 20-inch rows. Each of the three methods of seeding the legume is combined with each of the three methods of seeding the grass. Grass legume combinations included in the study are: Fescue and alfalfa, rescue and alfalfa, and rescue and Kobe lespedeza. The objective of this experiment is to evaluate seeding techniques and plant spacing as a means of establishing and maintaining grass-legume mixtures of desirable botanical composition.

A second experiment measures the effects of nitrogen level and frequency of clipping upon grass-legume combinations. Grasses used are fescue, orchard, and rescue. Legumes used are crimson clover, white clover, Kansas alfalfa, Chilean alfalfa, Kobe lespedeza, and Kansas alfalfa plus crimson clover. Each grass is grown in combination with each legume at two levels of nitrogen and two clipping schedules. The objective of this experiment is to develop management practices useful in maintaining desirable botanical composition at high yield levels of grass legume mixtures.

A large rotation experiment is designed (1) to determine whether row crops grown in rotations with sod crops will outyield row crops grown in continuous culture and (2) to determine the cause of any yield differences obtained. The sod crops used in this study include alfalfa, fescue-clover, Bahia grass and Coastal Bermuda grass. The row crops are corn and cotton. Split plot treatments of different levels of applied nitrogen fertilizer will be used to determine the effect of the rotations on nitrogen economy. Physical properties of the soils will be studied. This is planned as a 12-year experiment.

Plans also call for establishment of additional complete farm units to permit farm-scale evaluations of the findings of the plot experiments. One of the first of these farm units will be used for a study of beef cattle production, utilizing improved pastures. The predominant pasture grass used will be Coastal Bermuda.

These new experiments--added to existing work on soil and water losses as affected by grass-based cropping systems, grassland fertilization, and tillage practices for row crops in sod-based rotations--should help to provide much needed information on grass-legume sods of value in developing conservation plans for farmers in this area. Additional information on this work can be obtained by writing to the Southern Piedmont Conservation Experiment Station, Watkinsville, Ga.

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South Carolina. Fall and winter management of alfalfa in the Southeast. E. H. Stewart, Clemson.

Alfalfa Study: Removing Late Fall Growth Does Not Cut Stand or Yield

Four fall and winter management practices of alfalfa were tested at Clemson, S. C., in 1949, 1950, and 1951. These were (1) late fall growth left standing, (2) late fall growth cut and left on the ground as cover, (3) late fall growth removed for hay, (4) late fall growth removed for hay and additional cuttings made during the winter to simulate grazing. Results are shown in the table that follows. The winter months during the first two seasons were mild and humid. Thus, conditions were favorable for winter growth and also for insect and disease attacks. The third winter was rather dry and had several relatively severe cold periods.

As the table shows, the yields from each of the first three treatments were just about the same. The fourth treatment, which simulated grazing conditions, resulted in lower yields the first two years of the test. During the third winter, no additional cuttings were made to simulate grazing because there was very little growth after the first sharp freeze in November. None of the treatments affected the stand or the yield of cuttings made after the first spring cutting. This is to be expected if the plants are allowed to build up a normal food supply in the roots by letting them develop well into the bloom stage of growth during the regular growing season.

About 700 pounds of hay per acre were obtained each year from the late fall cutting and an additional 350 pounds from the winter simulated-grazing clippings. If this fall and winter growth is left in the field, it is usually killed back by cold weather, and it tends to lower the quality of the hay from the first spring cutting.

These tests indicate that removal of the fall growth following the summer management practices employed will neither materially injure stands nor reduce yields the following year. Fall growth may be used for grazing, as may some of the growth made later during winter mild periods. However, the alfalfa should not be grazed so closely as to injure the crown buds. Also, grazing when the soil is too wet may result in soil compaction or physical damage to the crowns of the alfalfa plants.

Alfalfa hay yield from first spring cutting following various winter treatments, Clemson, S. C., 1949-50-51

Treatment		Yield per acre from first cutting in spring of--		
Number	Description	1949	1950	1951
		Pounds	Pounds	Pounds
1	Late fall growth left standing	1770	2040	2140
2	Late fall growth cut and left as cover	1770	2080	2180
3	Late fall growth cut and removed as hay	1765	2140	2300
4	Late fall growth cut and additional cuttings made to simulate grazing	1540	1850	2160

Midwest

Wisconsin. Effect of crop rotations on soil and water losses. Clyde E. Bay, Madison.

Wheat Loses Least Soil, Corn Loses Most in Wisconsin Experiment, 1954

Rainfall was above normal and well distributed during the 1954 crop year. Four of the 14 storms causing erosion losses accounted for two-thirds or more of the total losses for the year. The intensities of the four storms and the losses from the three 4-year rotations are presented in the table that follows.

Plots were fall plowed for first and second crops following hay. Barnyard manure was applied at the rate of 5 tons per acre at time of seedbed preparation for the first crop after hay. A commercial fertilizer, 0-10-30, was applied broadcast at the rate of 400 pounds per acre in seedbed preparation for the second crop after hay. The hay mixture included alfalfa, timothy, and ladino clover for the three rotations. Plots were plowed and planted on the contour.

Winter wheat allowed the smallest loss of soil and water of the row crops under measurement. The wheat gets off to an early start in the spring and provides good cover and protection against damaging storms that may occur during the growing season. It is most vulnerable to soil and water losses in the fall after planting and during winter rain and thaw periods. The oats after hay allowed larger losses than the winter wheat but very much smaller losses than corn after hay and the oats before the hay crop. Oats are planted around April 20, and a good cover is usually established by the early part of June. Water losses continue at high rates after the cover is established, but soil losses are materially reduced.

Water runoff and soil losses from plots in three 4-year cropping systems, during intense storms, 1954 rotation experiment, Gugel Farm, Madison, Wisconsin1/

Storms2/		COHH Rotation				OOHH Rotation				WOHH Rotation			
		Corn		Oats		Oats-1		Oats-2		Wheat		Oats	
Date	Precipitation	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre
	Inches	Inches	Tons	Inches	Tons	Inches	Tons	Inches	Tons	Inches	Tons	Inches	Tons
5/27-28	2.15	0.44	3.48	0.51	1.42	0.18	0.24	0.64	2.88	0.02	0	0.66	2.38
5/31-6/1	2.40	0.87	5.22	0.83	1.70	0.34	0.40	0.84	3.75	0.03	0	1.13	4.72
6/21	3.76	1.61	11.54	2.46	0.70	1.30	0.48	2.08	1.86	0.48	0.14	1.88	0.97
7/3	2.63	1.76	10.62	0.73	0.28	0.32	0.11	0.83	0.40	0.34	0.08	0.62	0.20
Total		4.68	30.86	4.53	4.10	2.14	1.23	4.39	8.89	0.87	0.22	4.29	8.27

1/ Plots: Size, 20' x 200'; slope, 8 percent; soil, Miami silt loam.

2/ Storm intensities (inches per hour for time specified):

5/27-28 - 5 min., 4.80; 15 min., 2.68; 30 min., 1.04; 60 min., 0.70.
5/31-6/1- 5 min., 2.40; 15 min., 2.24; 30 min., 2.24; 60 min., 1.30.
6/21 - 5 min., 6.60; 15 min., 3.60; 30 min., 2.40; 60 min., 1.30.
7/3 - 5 min., 6.00; 15 min., 5.52; 30 min., 3.00; 60 min., 2.20.

Corn in 1954 allowed the greatest soil loss recorded since the experiment was started in 1949. Losses for the rains on June 21 and July 3 are incomplete records. Trash in the runoff plugged the collecting equipment and caused a partial loss of records. The corn was planted on May 13 and provided poor cover during this period of storms. It was cultivated the day before the storm of July 3.

Water losses from oats before the hay crop are quite uniform, but soil losses from grain after grain are twice as great as from grain after corn. These differences are influenced by the weed control treatment which grain areas receive. To control weeds in the cornless rotations, first-year grain areas are worked two and three times with the field cultivator after the grain crop is removed and before plowing in the fall. Each of these operations reduces the soil structure and allows a more rapid seal of the soil surface, thus increasing erosion losses. A chemical was used in the fall of 1954 to kill quack grass and other grass weeds in the hay and grain plots before plowing. If this method provides satisfactory control of grass and weeds, it will eliminate the destructive action of mechanical working of the field for control.

Cover and soil structure were the most important factors determining the erosion losses from the different rotation practices.

Illinois. Effects of rotations on infiltration. D. B. Peters, C. A. Van Doren, and Robert Burwell, Urbana.

Legume Rotation Improves Infiltration in Illinois

Field infiltrometers were designed to permit continuous recording of water intake by soils. The technique consisted essentially of a single ring basin, 40 inches in diameter, in which a small constant head of water was maintained by use of 55-gallon drums operating on a vacuum displacement bubbling principle.

The infiltration rates of soil under two long-time rotations were compared. A corn-corn-corn-soybeans rotation, thought to be conducive to soil physical deterioration, was compared to a corn-oats-clover-wheat rotation, which is thought to be beneficial in maintaining and improving soil physical conditions. This study was undertaken to determine the feasibility of using infiltration as a means of assessing soil physical conditions. The study was conducted on Muscatine silt loam. Results of the study showed that there was a very large difference in the infiltration rates. The average infiltration rate for the first hour for corn-corn-corn-soybeans was 2 inches per hour as compared to 17.5 inches per hour for corn-oats-clover-wheat. The total intake of water in 8 hours for the corn-corn-corn-soybeans rotation was 10 inches as compared to 48 inches for the corn-oats-clover-wheat rotation.

Results from the data indicated that infiltration could be used to assess the relative differences in management practices.

Infiltration rates also were taken over a continuous 8-hour period from plots at Urbana having received a polyelectrolyte soil conditioner in 1953. The rate of conditioner application was 2,000 pounds per acre. There was no experimental difference in the rates of infiltration or total water intake between soils that had received soil conditioner and soils that had not received conditioner. The soil studied was Drummer clay loam, a soil which possessed a moderate or high infiltration capacity on the untreated plots, averaging 15 inches per hour. Although observable differences resulting from conditioner application exist in the soil, the high infiltration capacity of the soil without conditioner prevented an expression of conditioner effects upon infiltration.

Great Plains

Texas. Crop rotations, Amarillo Experiment Station (Bushland). C. E. Van Doren, Bushland.

Crop Rotations Superior to Continuous Cropping for Dependable Yields

Twelve years' data, generally confirmed by 1954 results, indicate that a cropping system of wheat-fallow-wheat or a wheat-sorghum-fallow rotation with a mulch farming system will produce more consistent and dependable crop yields than continuous cropping. The 1954 data also showed that delaying subtillage operations until spring gave yields as good as or better than tillage following combining.

During the winter of 1954 surface soil samples were taken on the crop rotation plots at three different dates for dry aggregate studies. Percentage of aggregates less than 0.84 mm. in diameter increased from the first sampling date to the last during the winter season. This breakdown during the winter has been noted in previous years and is thought to be due in part to freezing and thawing action during this period.

Sorghum in the cropping system reduces the size of dry aggregates. In the 1954 samples, plots that had been cropped continuously to sorghum and plots that were fallow following sorghum had a higher percentage of small aggregates (smaller than 0.84 mm. diameter) than did plots cropped continuously to wheat and plots that were fallow following wheat.

The highest percentage of small aggregates was recorded for land that had been in grass for 6 years. Six years of cropping in a wheat-sorghum-fallow rotation following six years of grass seemed to have about the same effect on aggregation as a wheat-sorghum-fallow rotation without a period of grass.

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Texas. Water management studies. P. E. Ross, Weslaco.

Four Crops Being Tested for Improving Seedbed Preparation

Improved practices are needed to obtain satisfactory seedbeds for early spring crops under irrigation, especially for many of the lands that have been growing continuous cotton. An experiment with this need in mind was initiated to determine the value of Willamette vetch, Victor grain oats, hubam clover, and English peas for improving the soil condition so that satisfactory seedbeds may be obtained for early spring crops.

All the crops in this study have made excellent progress. Differences in root systems were noted during early December. Of the four crops examined, oats appeared to have by far the greatest tonnage of fibrous roots in the plow pan, which is thought to interfere seriously with good irrigation water management. While the roots of all crops had penetrated the compacted layer at the time the roots were excavated, the oats had not only penetrated the 6- to 18-inch zone but had reached a total depth of 48 inches with an abundance of roots through the 24-inch depth. Of the legumes, vetch seemed to have the best nodulation. Results of this study will be reported later.

Great Plains

Texas. Mulch farming studies, Amarillo Experiment Station. C. E. Van Doren, Amarillo.

Residues Prevent Wind Erosion

Wheat yields in 1954 on subtilled plots were higher than on plots plowed with a one-way. This was true where wheat followed wheat and where wheat followed fallow. These results conform to the 12-year averages of 9.5 and 11.3 bushels per acre for continuous wheat and 15.8 and 18.3 on the wheat-fallow plots.

Surface samples were taken on the stubble mulch plots during the winter of 1954 for dry aggregate analysis. The data were summarized on the basis of aggregates less than 0.84 mm. in size.

The two one-way disc plowed fallow plots started blowing when the percentage of surface soil aggregates smaller than 0.84 mm. amounted to 47.4. At this same time, all other plots in the stubble mulch series had a higher percentage of aggregates less than 0.84 mm. in size. This indicates that as far as surface soil conditions were concerned, all plots were in a condition to blow and that surface residue was necessary to prevent blowing.

Residue figures show that it takes only a small amount of certain kinds of residue to prevent wind erosion. Residue on the fallow plots was a late growth of annual grasses and a small amount of carry-over wheat straw; residue on the continuous wheat plots was wheat straw from the 1953 crop. Less than 200 pounds per acre of wheat straw was present on the continuous wheat plots where sweep tillage was used; the fallow plots with residue left on the surface had from 413 to 1,027 pounds per acre of annual grass and wheat straw.

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Texas. Effects of plant residues on soil moisture evaporation. A. R. Lemon, College Station.

Soil Temperatures May Be Higher at Some Depths Under a Residue Mulch

In a 1953 experiment at College Station, where plots were enclosed to prevent runoff, two different types of plant residue mulches failed to show any conservation of moisture. However, analysis of soil temperature data revealed a surprising fact: Soil temperatures were not reduced under a mulch, as expected, but were slightly increased at some depths. The mulch under which the temperatures were recorded consisted of a 10-ton-per-acre application

of chopped cornstalks. Similar data from a plant residue mulch plot and a bare soil plot on a sandy soil at Big Spring, Texas, revealed the same relationship. These results led us to believe that heavy plant residues on the soil surface may tend to conserve heat.

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Montana. Effect of crop residue and tillage practices on soil and moisture conservation. Laurence O. Baker, Havre.

Tillage Method and Stubble Practice Have Little Effect on Wheat Yield

Twelve treatments are included in a study of the effect of stubble utilization and tillage methods on moisture conservation in summer fallow, and on crop yields and grain quality of spring wheat. Six of the treatments have been studied since 1942. Six additional treatments were added in 1947. Plot size is slightly less than one-half acre, and all treatments are replicated three times.

Spring wheat plots: Yields, test weights and protein content of wheat and moisture content of fallow soil under various stubble utilization and tillage treatments. Averages for periods between 1943 and 1954.

Treatment	Yield per acre 1943-54 average	Yield per acre 1948-54 average	Test weight per bushel 1943-54 average	Protein content 1943-53 average	Soil moisture content[1] 1943-52 average
	Bushels	Bushels	Pounds	Pct.	Pct.
1. Tillage method non-rotated[2]					
(a) Stubble not burned					
Moldboard plow & rod-weeder	16.8	15.1	56.7	16.7	12.0
Oneway	16.3	14.1	56.5	16.4	12.2
Subsurface tillage	17.1	14.6	57.1	16.2	12.5
(b) Stubble burned before 1st fallow operation					
Moldboard plow & rod-weeder	17.0	15.3	56.9	16.6	12.4
Oneway	16.9	15.0	56.9	16.3	12.5
Subsurface tillage	16.3	14.4	56.7	16.2	12.6
2. Tillage method rotated[3]					
(a) Stubble not burned					
Moldboard plow & rod-weeder		14.4			
Oneway		15.1			
Subsurface tillage		15.1			
(b) Stubble burned before 1st fallow operation					
Moldboard plow & rod-weeder		15.2			
Oneway		15.3			
Subsurface tillage		15.3			

1/ Average percentage to the 5-foot depth measured at seeding time.
2/ Same tillage implement is used for each fallow period.
3/ Tillage implement is rotated--subsurface tiller for 1st fallow period, oneway for 2nd and moldboard plow and rod-weeder for 3rd fallow period.

The 10-year average percent of moisture to the 5-foot depth for fallow on which the stubble was burned is 12.5 and for unburned stubble it is 12.2. Subsurface tilled fallow has had a slightly higher average moisture content at seeding time than fallow prepared by either of the other methods.

Very little wind or water erosion has occurred on any of the treatments. However, the non-burned subsurface tilled fallow is most resistant to erosion.

Yield of spring wheat has been about the same for all methods of fallow although there is a slight tendency for continuous subtilled and onewayed fallow to yield less. All burned stubble plots have an average yield of 15.1 bushels compared to an average of 14.7 bushels per acre on the non-burned plots. While this difference is small, it is generally consistent.

Weed control has been more difficult on subsurface tilled fallow. Usually one more operation is required than for the other methods.

TILLAGE AND CULTURAL PRACTICES

Great Plains

Texas. Exploratory experiment: Grass establishment trials on deep, coarse-textured, rapidly permeable soil (SCS Soil Unit 13) under native Harvard (shin) oak. William C. Moldenhauer, Agent, Big Spring.

Buffel Grass Established Under Shin Oak--Other Grasses Fail

In this trial eight different grasses were seeded by two methods and with six different methods of treatment of the shinnery oak. The grasses used were sideoats grama, sand bluestem, little bluestem, weeping lovegrass, sand lovegrass, switchgrass, Indian grass and buffel grass. Two seeding methods were studied: Drilled (Hancock drill) and broadcast. Six treatments of the shinnery oak were: Check--none, Hegari mulch (300 pounds per acre), stalk cutter before seeding, stalk cutter after seeding, rotary brush chopper before seeding, and rotary brush chopper after seeding.

Subsoil moisture was very good at planting time, and there was an 0.80-inch shower right after the grass was planted. The lovegrasses, buffel grass, and switchgrass germinated and came up on this shower.

The plots were visited June 23, 1954. At that time many of the seedlings that had come up in May were gone. A number of buffel grass plants had survived and some weeping lovegrass and switchgrass plants.

From June 20 until October 5 no rain fell on these plots. They were revisited October 7. At this time only a few weeping lovegrass plants were

found in low spots (blow-out spots) where moisture conditions were more favorable. The buffel grass had a fairly high stand survival in places, and a few surviving plants could be found most places. The plants looked vigorous after the rain and most of them made seed heads. The height of plants was 4 to 8 inches.

Conclusions from this study are:

1. Unless more effective methods of establishing grasses under the present climatic conditions in Midland County can be found, the introduced grasses such as buffel and weeping love with short germination periods have a better chance of success in range seeding of this kind than do the native grasses.

2. Broadcast seeding was entirely ineffective as a method. Drilling with a grass drill with depth regulating bands on the disk was a great deal more effective.

3. Disturbing the surface soil seems to be a very important requisite for stand establishment on soils of this type. Treatment with a stalk cutter before seeding proved more effective than a Hegari mulch in aiding stand establishment. The effect of soil disturbance is of course not a new discovery. Some work done by M. D. Atkins on the Elkhart LU project with stand counts on aerial seeded plots shows that soil disturbance before seeding increased the stand greatly.

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Texas. Row spacing of grain sorghum. W. C. Moldenhauer and F. E. Keating, Big Spring.

<u>Most Effective Row Spacing for Grain Sorghum Varies With Year and Variety</u>

Perhaps the most effective wind erosion control measure possible on cropland in this area is close row spacing of sorghums. Trials with variable row spacing and plant population have been carried on at Big Spring Field Station since 1945.

Conclusions from this work are as follows:

1. Except in the case of the 1946 results and the 4-year results with Bonita grain sorghum, no significant difference was found between yields from 22- and 44-inch rows. The difference due to row spacing in 1946 was about $2\frac{1}{2}$ bushels per acre and the difference due to Bonita grain sorghum was about the same.

2. Plainsman grain sorghum was found to yield significantly more than Bonita and Midland significantly more than Day.

3. Interactions that may prove significant:

a. Years x plant population.

Trends in yields due to differences in plant population could be measured in 1945, 1948, 1949. In 1945, a favorable year, yields decreased as plant population decreased. In 1948, 1949, and 1954, all dry seasons, lower populations gave a higher yield.

b. Row spacing x variety.

In 1954 the Plainsman grain sorghum gave higher yields in 22-inch rows while Bonita gave higher yields in 44-inch rows. In the late planting analysis, Midland gave higher yields in 22-inch rows while Day gave somewhat higher yields in 44-inch rows.

c. Row spacing x plant population.

In 1954 with 44-inch rows the yield increased as the plant population decreased. With 22-inch rows the yield decreased as the plant population decreased except for the lowest population.

d. Years x row spacing.

This interaction was significant. In 1946 and 1950 the 44-inch rows gave higher yields and in 1949 and 1954 the 22-inch rows were higher with Plainsman sorghum. With late planted sorghum in 1948 and 1949 the 44-inch rows yielded higher, and in 1945, 1951, and 1953 the 22-inch rows were higher.

The yields for each of the years 1949, 1951 and 1953 can be considered to be essentially the same for each row spacing. The year 1945 was very favorable for sorghum production and in this year the 22-inch rows outyielded the 44-inch rows by 325 pounds (21 percent). In 1948, a year very unfavorable for sorghum production, 44-inch rows outyielded 22-inch rows by 222 pounds or 58 percent.

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Texas. Seedbed preparation for milo, kafir, and cotton. F. E. Keating, Superintendent, Field Station, Big Spring.

Milo Benefits from Winter Listing

Data collected from 1926 to 1948 showed that milo appeared to benefit somewhat from winter listing and to be more productive when planted in the lister furrows. Cotton appeared to benefit very slightly from winter tillage but in contrast to milo, produced slightly higher yields when the ridges were split than when planted in lister furrows. Kafir did not appear to benefit from winter cultivation. The highest yields of both kafir and cotton were produced on land that was winter plowed and the crop planted with furrow openers.

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South Dakota. To determine the optimum combinations of plant population, method of planting, and fertilizer application for production of irrigated and non-irrigated corn in the James River Basin, Redfield Development Farm. Lawrence O. Fine, Brookings.

In Thick Corn, Heavier Ears Result from Drilling than from Hill Planting

In two experiments--one irrigated, the other not--corn was planted by hill and drill methods at populations of 19,360, 14,520, and 9,680 plants per acre in the non-irrigated experiment and at 19,360 and 14,520 in the irrigated experiment. Nitrogen fertilizer was applied at 0, 40, 80, and 120 pounds of nitrogen per acre for all plots.

In the non-irrigated experiment, yields were little affected by fertility because of summer fallow operations on the land the previous year. Yield differences were slight also, except that hill-planted corn at 9,680 plants per acre yielded less than other population-method of planting combinations.

In the irrigated experiment, drill planting proved superior to hill planting by 105.5 vs. 88.0 bushels in the 19,360 population and by 100.4 vs. 89.0 in the 14,520 population. In this experiment, nitrogen fertilizer had only slight effect on yield.

The effect of the various culture methods on ear weight, as revealed in the following table, was considerable. Nitrogen had little consistent effect, and the values given are averages of all nitrogen levels.

Average ear weights of corn grown under irrigated and non-irrigated conditions in various plant population-method of planting combinations, Beatia silt loam, Redfield Development Farm, S. Dak., 1954

	Treatment		Average weight per ear
	Plants per acre	Planting method	
			Pound
Experiment on Non-irrigated Land:	19,360	Hill	.306
		Drill	.357
	14,520	Hill	.381
		Drill	.426
	9,680	Hill	.494
		Drill	.489
Experiment on Irrigated Land:	19,360	Hill	.345
		Drill	.447
	14,520	Hill	.436
		Drill	.430

The important observation seems to be that drill planting shows an advantage over hill planting under non-irrigated conditions at high plant populations. This advantage progressively decreases with a decrease in the number of corn plants per acre. Under irrigation, there is likewise an advantage for drill planting, but the advantage apparently is lost earlier in going to lower plant populations.

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Kansas. Effect of deep tillage on infiltration. R. J. Hanks and F. C. Thorp, Manhattan.

Subsoiling Effect on Infiltration Not Significant in Kansas Tests

Water was added at an average intensity of 3 inches per hour for 1 hour to soils which had been tilled with various deep tillage implements. The infiltration rate of the Munjor silty clay loam averaged 1.75 inches per hour on the control plots and 2.06 inches per hour on the plots where the soil had been deep tilled with a chisel and/or subsurface sweeps. On the Colby silt loam the infiltration rate for the first hour was 2.4 and 3.0+ inches per hour on the check and subtilled plots, respectively. On the Ladysmith silty clay loam the infiltration rates were 1.93 (check) and 2.73 (subsoiled) inches per hour and on a fine sandy loam with a plow pan (near Garden City, Kansas) the rates were 2.28 (check) and 2.47 (subsoiled). On the Idana clay loam the infiltration rates were 2.81 (check) and 2.96 (subsoiled) inches per hour. In general, subsoiling increased the average infiltration rate the first hour but the differences were not significant at the 5 percent probability level. There were no differences measured between the depth of subsoiling and the type of instrument used. Additional tests will be made next year.

West

Arizona. Effect of subsoiling and use of a soil amendment in leaching an unstratified saline soil, Yuma Mesa Soil and Crop Laboratory. C. O. Stanberry, Yuma.

Subsoiling Increases Salt Removal by Leaching Below Two Feet

Approximately 50,000 acres of irrigable land in the Wellton-Mohawk Irrigation District of southwestern Arizona has a high silt content. The silty mantle may be several feet thick and is underlain by coarse sand. Much of the soil in this new reclamation project contains more than 3 percent water-soluble salts, sodium chloride being dominant.

A number of the new settlers on this project believe that subsoiling the land will aid in leaching the excess salts from the surface soil layers prior to planting the first crop. Others have been led to believe that gypsum, sulfur, or other soil amendments will aid in the leaching process, even though an appreciable amount of indigenous gypsum is present in the soil and the

Colorado River water used for irrigation and for leaching contributes about 1,000 pounds of gypsum per acre foot of water.

An experiment was designed to give information on the effect of the practices in question. Field plots, replicated six times, provided for 0-, 18-, and 32-inch depth subsoiling and applications of gypsum at rates of 0, 2, and 10 tons per acre.

After soil sampling to 48 inches, a preplanting leaching with 56 acre-inches of water, over a 2-week period, was applied uniformly to all plots.

Double Dwarf 38 grain sorghum was planted July 17 as the indicator crop, 100 pounds of nitrogen and 100 pounds of P_2O_5 per acre having been broadcast and incorporated in the soil during seedbed preparation. Soil samples were again taken before planting and following crop harvest.

A total of about 29 acre-inches of water was applied to the crop in six irrigations. Yield data were obtained for both grain and fodder, and the electrical conductivity was determined on the saturation extract of all soil samples.

The percent of salt removed from the surface 48 inches of soil by the initial leaching as influenced by subsoiling is shown in the accompanying chart.

Summary of results:

1. Fifty-six acre-inches of irrigation water used in leaching this very salty silt loam reduced the salt concentration of the surface 24 inches until moderately tolerant crops may be grown.

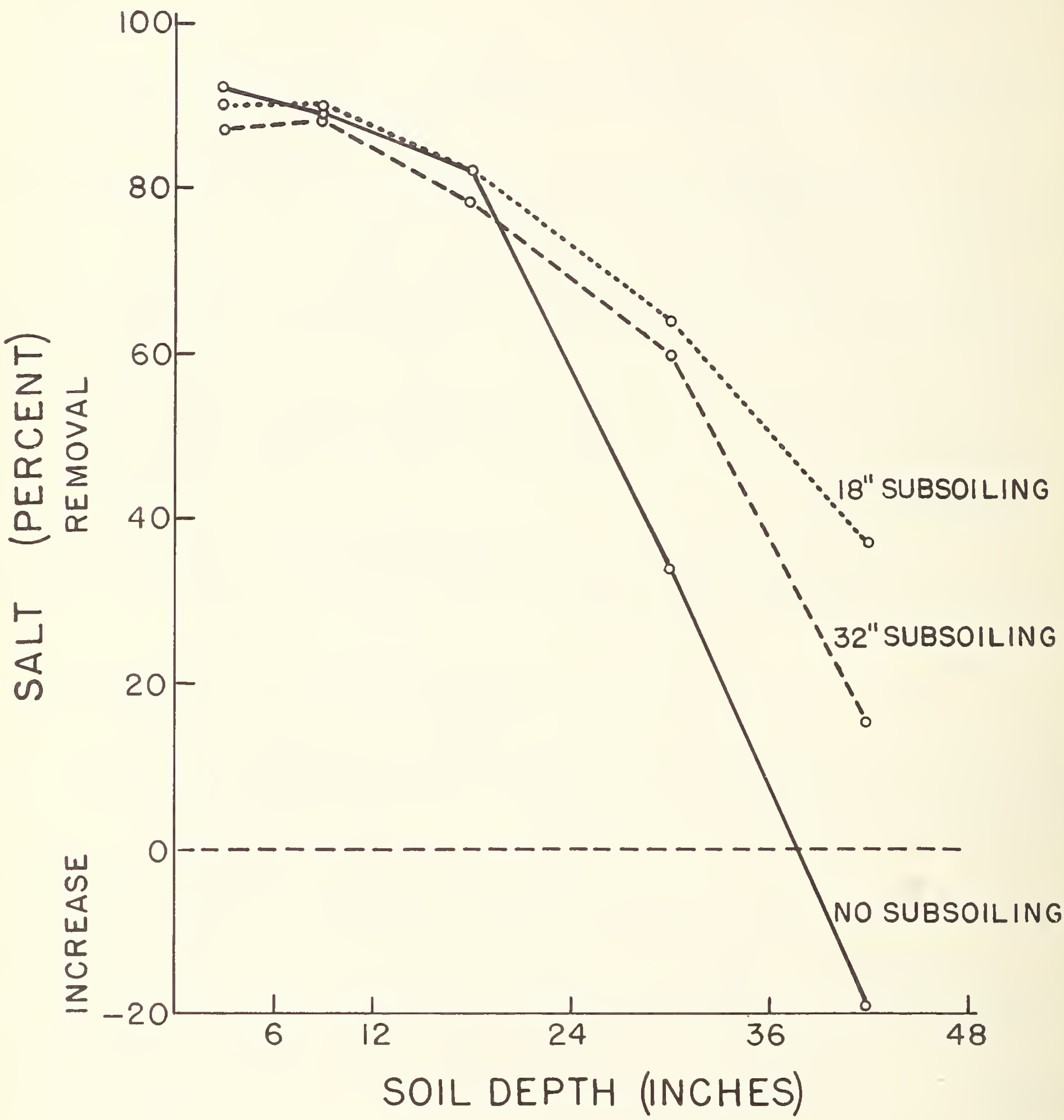
2. Subsoiling this unstratified virgin soil was unimportant in affecting reclamation of the surface 2 feet but did increase salt removal in the third and fourth foot. This was of no practical importance during the first crop season since salt levels below 24 inches, although different, were all too high to permit satisfactory crop growth. It seems probable that the money spent for subsoiling could have been used more profitably in applying additional leaching water prior to cropping.

3. The application of 29 acre-inches of irrigation water apparently was insufficient (above crop requirements) to effect further reclamation.

4. An abundance of gypsum was present below the 9-inch depth in this soil and supplemental applications were of no benefit.

5. Unsatisfactory sorghum grain yields from these plots were apparently caused by lack of pollination and did not appear to be associated with soil salinity.

PERCENT OF SALT REMOVED FROM SURFACE 48 INCHES BY INITIAL LEACHING AS AFFECTED BY SUBSOILING



Idaho. Effect of tillage and fertilizer treatments on annually cropped spring wheat. F. H. Siddoway, St. Anthony.

Tillage Practice Materially Affects Spring Wheat Yield

An experiment was established in 1954 for the purpose of learning the effects of tillage and the use of nitrogen fertilizer on the yield of annually cropped spring wheat. Wheat following summer fallow was included so that a comparison between the two cropping systems could be made.

Yields of spring wheat were quite low in 1954. It was estimated that frost damage reduced yields by one third. Nitrogen was apparently adequate since yields were not influenced significantly by application of nitrogen fertilizer. Yields were influenced significantly by tillage practice as indicated by the following table:

Yields of spring wheat with different tillage practices, St. Anthony, Idaho, 1954

Tillage treatment	Yield per acre 1/
	Bushels
Wheat after wheat	
Fall plow-moldboard	5.1
Fall chisel--spring plow sweep	10.4
Spring plow-sweep	8.2
Spring plow-moldboard	6.2
Wheat after fallow	
Fall chisel--spring plow sweep	17.4
LSD (5% level)	3.1

1/ Each value is a mean of five fertilizer treatments

Soil moisture storage preceding seeding was influenced by tillage practice, and yield was directly correlated with the amount of available water in the soil at seeding time. The results indicate that soil moisture was the most important factor controlling yield of continuous spring wheat during 1954.

Southeast

Alabama. Effects of soil moisture availability, rainfall and irrigation on evapotranspiration by white clover. H. A. Weaver and R. W. Pearson, Auburn.

Rain, Irrigation Changes Evapotranspiration Rate and Relationships

Soil moisture changes at a 6-inch depth in four irrigated and four non-irrigated white clover plots were followed during the summer of 1954 at Auburn. The soil was a Norfolk sandy loam. Moisture determinations were made through use of gypsum blocks located in each plot. The difference in the soil moisture content as represented by average block readings between any two given dates provided a measure of evapotranspiration which was assumed to be representative of the 3- to 9-inch soil layer. The results showed:

1. Evapotranspiration rate from the 3- to 9-inch soil layer was markedly reduced immediately following rain or irrigation of .30 inch.

2. This effect of rainfall and irrigation on evapotranspiration was independent of soil moisture content. Also, no change in relative humidity or temperature could be found which would account for the reduced evapotranspiration.

3. Evapotranspiration rate gradually increased during periods subsequent to rainfall or irrigation until a peak rate was reached. Beyond this peak a decline was observed which was due to the gradual decrease in soil moisture availability.

4. Where the depressing effects of rainfall and irrigation were ignored, the relationship between soil moisture availability and evapotranspiration was found to be linear and of the approximate form $y = \frac{x}{500}$ where y equals inches daily evapotranspiration from the 3- to 9
daily evapotranspiration from the 3- to 9-inch soil layer and x equals percent of available water present.

Great Plains

Oklahoma. Fertilized and unfertilized native grass pastures, Red Plains Station. Harry M. Elwell, Harley A. Daniel, and Maurice B. Cox, Guthrie.

Fertilizer Applications Increase Steer Gains on Native Grass

Work on pasture fertilization now under way is located on two different types of land: (1) Abandoned cultivated land which had been returned to

grass after becoming badly eroded and gullied (Class VII land); and (2) virgin land from which brush (chiefly scrub oak) had been cleared and a good stand of native grass established. Good yearling white-face steers are grazed during the summer growing season and their gains are measured. The steers averaged about 535 pounds when they went on pasture during the seasons reported here. The grazing season was 121 days in 1952, 130 days in 1953, and 104 days in 1954.

Fertilized pastures in 1952 received 300 pounds of superphosphate (0-20-0), applied with a distributor which splits the sod and places the fertilizer about 4 inches deep in furrows 30 inches apart. The plan is to repeat this application at 3-year intervals, making an annual average of 100 pounds of superphosphate per acre. Nitrogen fertilizer is applied on the soil surface annually in the last week of May at a rate equivalent to 33 pounds of nitrogen per acre.

The 1954 season was quite different from others of the past; for that reason, the results for 1952, 1953, and 1954 are recorded separately for comparative purposes.

Steer gains from grazing fertilized and unfertilized native grass pastures on two types of land, seasonal per animal and per acre and daily per animal, Guthrie, Okla., 1952, 1953, 1954

Type of land	Pasture number	Treatment	Grazing season	Acres per animal	Gain per steer for season[1]	Gain per steer per day	Gain per acre for season[1]
					Lbs.	Lbs.	Lbs.
Eroded	2	Fertilized	1952	3.75	316	2.61	85
			1953	3.75	276	2.12	75
			1954	3.00	178	1.71	59
			Av.	3.50	257	2.15	73
	3	Unfertilized	1952	5.00	285	2.36	57
			1953	5.00	240	1.85	48
			1954	4.29	104	1.00	24
			Av.	4.76	210	1.74	43
Virgin cleared brush land	8	Fertilized	1952	2.50	334	2.76	134
			1953	2.30	304	2.34	132
			1954	2.00	172	1.65	86
			Av.	2.27	270	2.25	117
	7	Unfertilized	1952	3.33	321	2.65	96
			1953	3.33	242	1.86	73
			1954	2.73	143	1.38	52
			Av.	3.13	235	1.96	74

1/ Grazing period in 1952 was May 1 to August 29 (130 days); in 1953, April 24 to August 31 (121 days); and in 1954, May 7 to August 18 (104 days).

During this 3-year period, animal gain per acre in the fertilized pasture on eroded Class VII land was 1-1/7 times that in the unfertilized. On virgin soil from which brush had been removed, the per acre gain without fertilizer was about the same as on the eroded soil where fertilizer was applied--73 pounds as compared to 74 pounds. When this virgin land was fertilized, the gains were increased by almost 58 percent--from 74 to 117 pounds.

The amount of precipitation received during different parts of the 3-year period was as follows:

Period	Precipitation			
	1952	1953	1954	Average
	Inches	Inches	Inches	Inches
January through April	7.94	9.02	3.24	6.73
May through September	10.44	16.66	8.88	11.99
October through December	2.63	8.10	3.30	4.67
Total	21.01	33.78	15.42	23.39

In 1953, good fall rains occurred, and, after the grazing season, the grass produced seed. An average of 78 pounds per acre of native grass seed was harvested from the fertilized pastures and only 42 pounds from the unfertilized.

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Wyoming. Seeded dryland pastures. O. K. Barnes, Sheridan.

Sheep Gains Greater on Seeded Grass-Legume Pastures Than on Native Range

A study was started in 1953 on land that had supported some native and crested wheat grass but was then in a low state of productivity. In the fall of 1952, after the area was fully grazed, the land was plowed and left rough through the winter. In early March the ground was disced, harrowed, packed and seeded to the various grass-legume mixtures to be studied. These operations were completed by March 20, 1953.

Three new grasses that have shown promise for the area in small plot tests were used in the study. These grasses were Manchar brome, Primar and Pubescent wheatgrass. Duplicate pastures of these grasses were seeded at the rate of about 6 pounds per acre plus 3 pounds of Ladak alfalfa. On either side of this series of six pastures are virgin native range pastures similar in soil and topography to the seeded pasture area, which are used as a comparison with the seeded pastures.

These pastures are situated on land classed as a light fine sandy loam varying from a single grain structure to a very weak fine crumb structure. One replicate lies on a slope of about 10 percent and the second replicate on a slope of 3 to 4 percent.

Growing season precipitation in 1953 was 25 percent below the long-time average and in 1954 was 40 percent below normal. However, all seedings became well established and light grazing was possible in the fall of 1953. Experimental grazing began in May 1954.

Results:

Under these rather dry conditions, the pastures provided an average of 4.1 sheep months of grazing per acre in 1954. For this first year all pastures were stocked at the same rate and with uniform groups of ewes and lambs. The period of use was May 17 to July 1 and August 17 to September 7.

Manchar brome-alfalfa mixture produced the top lamb gains with an average of 44 pounds per head. Primar and Pubescent wheatgrass and alfalfa mixtures produced just slightly lower gains with 39 and 42 pounds per head, respectively. Native range produced 28.8 pounds gain per head. The seeded pastures, taken as a group, produced an average of 13 pounds more gain on each lamb than did native range. This amounted to 26 pounds more lamb per acre. At 1954 prices for lamb, this is $4.50 per acre in favor of the seeded pastures. The ewes on the seeded pastures made especially good gains, averaging 23 pounds per head as compared with 12 pounds per head on the native range.

One of the problems involved in plowing and seeding such light soils is the risk of increased exposure to wind and water erosion. One observation made in setting up this study was that the exposure risk is minimized considerably by plowing the old grass late in the fall. Leaving this sod in a rough condition through the winter allows little opportunity for wind erosion in this area, and the soil holds whatever moisture is received. Then, with very early spring seeding, the new grasses have a reasonable chance of becoming established before the binding effect of the old grass roots is lost and before the period of washing rains occurs. Farming such land to grain a year or more would appear to greatly increase the hazards to establishment of perennial grass.

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Wyoming. Mountain meadow investigations. Rulon D. Lewis, Laramie.

Native Meadows Respond to Nitrogen Fertilizer and Proper Irrigation

Moisture and fertility requirements of native meadow, grass-legume mixtures and some nine individual grass species are being studied at Pinedale. The results after 4 years' study show:

1. When irrigation water is properly applied, nitrogen becomes the limiting production factor in the area.

2. Highest hay yields were obtained when native meadow and grass-legume mixtures were treated with 80 pounds of nitrogen per acre and irrigated every 7 days during the growing season, allowing the water to remain on the plots for approximately 6 hours. Hay yields were more than doubled by this treatment compared with no treatment.

Studies to determine the effect of fertilizer, renovation and time of seeding upon grass-legume mixture establishment in native mountain meadows without irrigation water control indicate that there is no yield advantage in reseeding and fertilizing compared to fertilizing alone. At Pinedale, 80 pounds of nitrogen per acre increased the yield over renovation, reseeding and no fertilizer 186 percent. Similar experiments at Crowheart show an increased yield of hay and crude protein for each additional increment of nitrogen ranging from about ½ ton of hay without nitrogen treatment to 2.7 tons with 320 pounds of nitrogen per acre. Yields of crude protein increased from 84 pounds per acre to 672 pounds per acre for the heavy nitrogen treatments.

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Colorado. Mountain meadow research. Forrest M. Willhite, Hayden K. Rouse, Eugene Siener, and A. R. Harris, Gunnison.

Early-Cut Mountain Meadow Hay Higher in Quality Than Late-Cut

An experiment has been in progress since 1950 on the high altitude meadow near Gunnison, Colorado, to determine the relationships of water control, sod management, fertilizer application and date of harvest on yield and quality of hay. Data are presented in the accompanying chart to show the influence of harvest data on yield and quality of meadow hay. These results may be summarized as follows:

1. Yield of hay is the same whether it is cut late (last part of August) or cut early (first half of July) and the aftermath (last part of August) included.

2. Crude protein percentage in the late-cut hay was appreciably less than in the early-cut hay. Thus, the early-cut hay produced approximately 300 pounds more crude protein per acre than the late-cut hay.

3. Phosphorus content of the late-cut hay was 0.18 percent compared to 0.28 percent for the early-cut hay. As a result, there was approximately 5 pounds more phosphorus per acre in the early-cut than in the late-cut hay.

4. On the basis of crude protein and phosphorus percentages, the early-cut hay is superior in quality to the late-cut hay.

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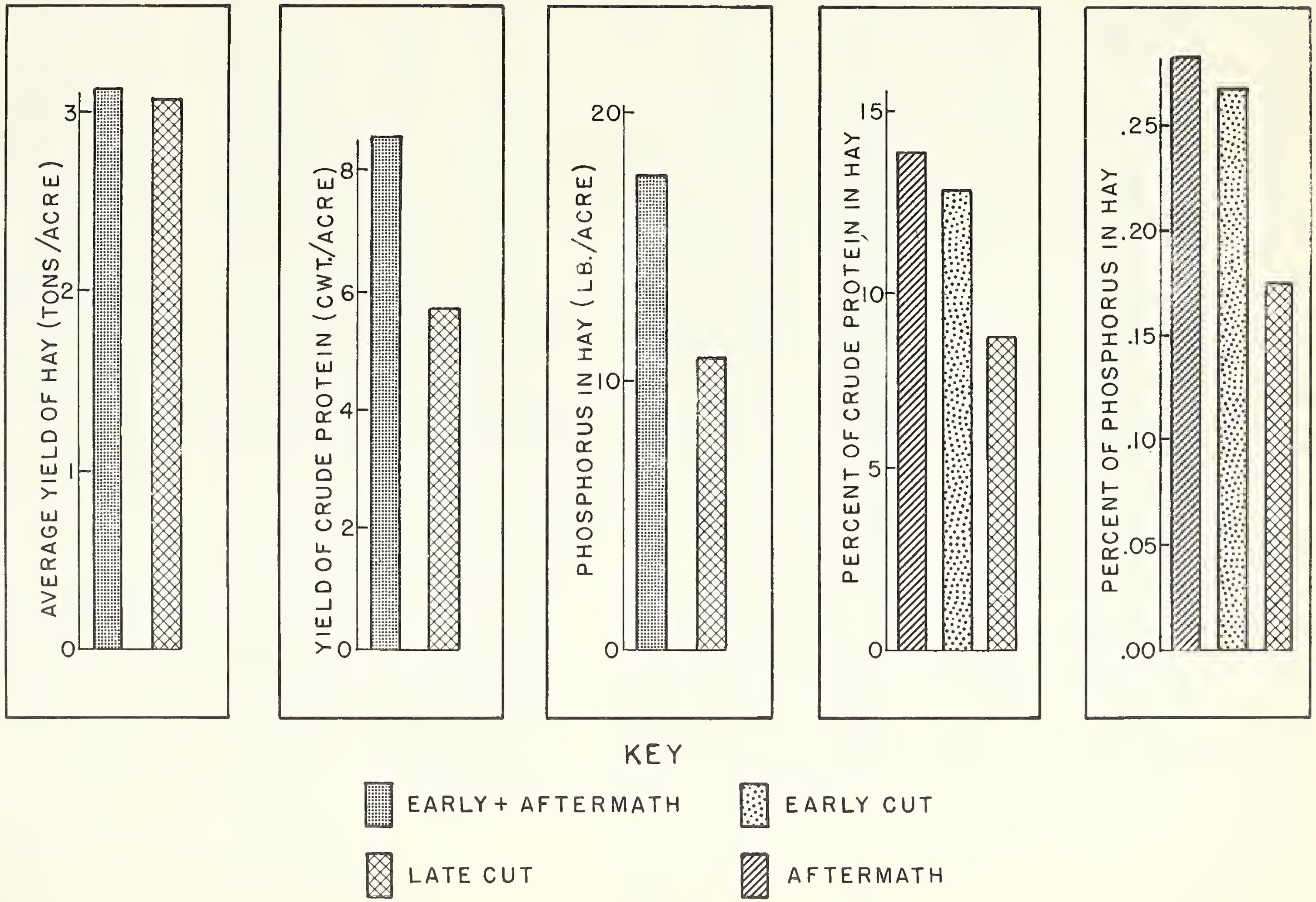
Texas. Relation of cotton yield to climatic factors. William C. Moldenhauer, Agent, Big Spring.

Cotton, Milo Yields Correlated with Annual Precipitation

Examination of simple correlation coefficients shows the annual precipitation measured from September 1 to September 1 to be more highly correlated with yield of both cotton and milo than any other factors studied.

Average 5 year effect of harvest time on the yield and quality of mountain meadow hay at Gunnison, Colorado. Blackstock 1950 - 1954.



Preseasonal precipitation (October 1 to May 1 for milo, September 1 to May 1 for cotton) is more highly correlated with crop yield than is the seasonal rainfall.

For cotton, the August average mean temperature shows a much higher correlation with yield than the average mean temperature of any other month. However, the coefficient for August average maximum temperature is almost as high. For July the average minimum temperature is more highly correlated with the yield of cotton than is either July average maximum or July average mean temperatures. In June and August the reverse is true.

For milo there is not a great deal of difference in correlation coefficients between yield and average mean temperatures of June, July, and August. (Note: All coefficients, temperature vs. yield, are negative.)

March maximum wind velocity is significantly correlated with the preseasonal precipitation (October 1 to May 1). Coefficients approaching significance were found between April maximum and April mean wind velocities and the 12-month period prior to May 1.

It should be emphasized that this is a preliminary survey and that these data will be subjected to a multiple regression analysis before the study is completed. The findings do, however, show the importance of total annual precipitation in producing a crop in this area. This precludes the use of a growing winter cover crop unless it is to be carried through the following summer season.

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Texas. Study of climatic factors that may affect wind erosion and water conservation, Amarillo Experiment Station. C. E. Van Doren, Bushland.

Yield from Continuous Wheat Closely Related to October-June Precipitation

Wheat. Seasonal precipitation (October 1 to July 1, October 1 to June 1, September 1 to July 1, September 1 to June 1, and November 1 to June 1) has a highly significant relationship to wheat yields. The highly significant correlation coefficient between October 1-June 1 precipitation and yields of continuous wheat leads to the conclusion that the precipitation during this 8-month period is the precipitation of importance in the production of wheat on a continuously cropped basis in this area.

Coefficients of correlation between monthly precipitation and wheat show that precipitation during April, May, October, and November is very important for continuous wheat production in this area. There is no significant relationship between the precipitation for an individual month and wheat yield; however, total precipitation for these four months is highly significant. April and May together show a highly significant correlation coefficient and October and November a significant correlation coefficient.

Maximum temperatures during May have a marked effect on continuous wheat yields. The mean temperatures for May and June affect wheat yields.

Evaporation during April, May and June has a definite relationship to wheat yields.

Sorghum. Annual precipitation, on a calendar year basis and crop year basis, shows definite relationship to continuous sorghum production. Seasonal precipitation, considered by periods including the months of April, May, and June, has marked effects on continuous sorghum yields.

Preseasonal precipitation for the April 1 to June 1, March 1 to June 1, October 1 to June 1, and September 1 to June 1 periods is significantly correlated with sorghum yields.

The only significant correlations between continuous sorghum yields and temperatures are maximum and mean temperatures for the month of June.

Evaporation also gave some significant correlations relating to continuous sorghum yields. Evaporation in June showed a highly significant negative correlation with yield. May and July evaporation showed a significant negative correlation with yield.

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Oklahoma. Soil moisture and ground cover studies, Panhandle A. & M. College, Goodwell.

Yields of Spring Wheat Related to Planting Date and Moisture Efficiency

During a study of factors affecting moisture efficiency in the northern spring wheat belt, a high degree of correlation was noted between preparatory season temperature and the soil moisture penetration per inch of rainfall. Moisture efficiency was significantly related to amounts of soil moisture stored before seeding and to the grain yields harvested.

During the past quarter, a study was made of the data collected during the period 1944-50 to determine the relationships between mean seasonal temperature of the preparatory period, moisture efficiency, and spring wheat yield per acre according to dates of seeding. It was reasoned that delayed seeding might add substantially to the mean temperature of the preparatory period.

Results of this study support the following conclusions: Adding a fallow season to the preparatory period for spring wheat resulted in yields that did not equal the annual rate of production obtained on continuously cropped land. Seasonably warmer winters favorably affected moisture efficiency, but increasing the mean temperature of the preparatory period by adding a fallow season worked in the opposite direction due to the wastage of moisture incidental to a long-drawn-out period of idleness.

Variation in date of seeding in the spring did not substantially affect the preparatory season temperatures. Lateness of seeding was, however, strongly related to moisture efficiency and crop yield.

Kansas. Infiltration studies on various soils with varying amounts and kinds of cover, Fort Hays Agricultural Experiment Station, Hays. Frank Rauzi, Laramie, Wyo.

Infiltration Rate of Native Pasture Land Influenced by Degree of Grazing

In the spring of 1954 water-intake measurements were made at the Fort Hays Station. Three native pastures which had been grazed at three intensities of use (light, medium and heavy) since the spring of 1946 were used for the study. At the time of tests the pastures had been grazed 8 years with these degrees of use.

Measurements were made by applying simulated rainfall with a mobile raindrop applicator. Test plots 2 x 2 feet in size received simulated rain at rates exceeding the rate of infiltration. The intake rate during the second 30-minute period of a 1-hour test was used to compare one plot with another. Use of this period minimized the differences between plots due to variations in soil moisture content and to water interception by different quantities of plant cover. To reduce soil variations, fence line contrasts were used. Three replicated tests were conducted on each side of the fence. Plant cover, mulch, and live vegetation and bare ground were determined on each plot by a point quadrat system of study.

Soils on these pastures were developed from Loveland loess on nearly level uplands and were characterized by a black, silty clay loam surface and by brown silty clay or silty clay loam blocky structured subsoil underlain by brown calcareous silts.

Average rates of water-intake during the second 30-minute period were as follows: On the light-use pasture, 1.58 inches per hour; on the medium-use pasture, 1.19 inches per hour; and on the heavy-use pasture, 0.73 inches per hour. Water intake rate on the heavy-use pasture was 54 percent less than on the light-use pasture during the second 30-minute period. Differences in water intake rate due to intensity of grazing were statistically significant at the 5% level.

Western wheatgrass was the dominant grass in the light-use pasture; buffalo grass and blue grama grass were dominant in the heavy-use pasture.

All standing vegetation in the test plot, including the previous year's growth, was clipped at ground level, and weight data were based on the air-dry weights of this material. These sample plots indicate that light-use pasture produced 1,271 pounds of vegetation per acre. This was 707 pounds or 44 percent more than on the heavy-use pasture.

Washington. Runoff studies, Soil Conservation Research Station. Glenn M. Horner, Pullman.

Runoff Not Always Greater on Upper Than Lower Slopes

Runoff from unfrozen soil in the Palouse wheat area is usually greatest on the upper south slopes. These areas have a thinner topsoil and the subsoil is more slowly permeable to water. Land on the lower slopes, where the topsoil is deeper and the soil profile is more permeable, usually has less runoff.

However, frozen soil may show quite different runoff pattern, as indicated by measurements obtained for the storm of December 30-31, 1954. This storm produced 0.78 inch of rain, which fell on a snow cover of 6 to 8 inches depth. The snow was rapidly melted by the rain and a warm wind. Alternate freezing and thawing periods during the previous 2 weeks had resulted in different degrees of soil freezing at various locations.

Runoff was measured on the crop rotation plots, which are located on the upper portion of a 30-percent south slope with a topsoil depth of 8 inches, and on the clover utilization plots, which are on the lower portion of a 20-percent northwest slope with about 18 inches of topsoil.

For plots with a uniform cover of winter wheat seeded on plowed land, the average runoff from the crop rotation series was only 0.01 inch compared to losses averaging 1.88 inches from the clover utilization plots. Soil on the wheat plots was found to be thawed out at the end of the storm, while the clover plots still had tightly frozen soil at a depth of ½ inch. The rate of infiltration on the clover plots was nearly zero; the water content of the snow cover plus the rain was about equal to the runoff.

Treatments applied to these areas had no apparent effect on the amount of runoff.

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Washington. Effect of moisture, nitrogen fertilizer, and clipping on Ladino clover-orchard grass pasture under irrigation. C. E. Nelson and J. S. Robins, Prosser.

Ladino-Orchard Pasture Responds to Combination of Practices

Third-year data have now been summarized in a study of the effects of clipping when 6 and 12 inches high, 3 moisture levels, and 8 nitrogen treatments on the yields, botanical composition, and nitrogen uptake by plants of a Ladino clover-orchard grass pasture under irrigation.

The three moisture treatments are: M1, 14 irrigations with net input of 47.5 inches; M2, 7 irrigations with a net input of 30.1 inches; and M3, 5 irrigations with a net input of 27.2 inches.

Nitrogen was applied at varying rates and times ranging from a single application of 50 pounds (N) to a maximum of 200 pounds in four applications.

Botanical composition was determined by hand separation for each cutting.

Conclusions from the results obtained:

1. The weight per acre of nitrogen in the grass (less N from fertilizer) is correlated with the percentage of Ladino clover.

2. Average total yield of forage per acre increased with each added increment of nitrogen.

3. Clipping when the plants were 12 inches high gave higher yield than clipping when the plants were 6 inches high and did not reduce the percentage of clover.

4. Yields of grass and clover were increased with the more frequent applications of water.

5. Higher applications of nitrogen decreased the percentages of Ladino clover.

6. Where M1 and M2 treatments were used, without fertilizer, third-year plants had about the same botanical composition as first-year plants.

7. In terms of yields with little loss of Ladino clover in the mixture, the best combination of practices is frequent watering (M1), clipping when the plants were 12 inches high, and split application of nitrogen fertilizer totaling 100 pounds N per acre.

HYDROLOGY

HYDROLOGY--GENERAL

Northeast

Maryland. Peak rates and amounts of runoff from agricultural watersheds in the Northeastern States. Harold W. Hobbs, Project Supervisor, College Park.

Hurricane Characteristics Require Consideration in Structure Design

Three notable hurricane storms, "Carol," "Edna," and "Hazel", passed over watersheds under study in Maryland, New Jersey, New York, and Maine in August, September, and October 1954. Along their paths, winds and rains caused much damage and flooding to agricultural lands, crops and buildings, as well as to highways, railroads and urban communities. In places, there was considerable loss of life, both human and animal.

Carol. On August 30 and 31, the center of low atmospheric pressure, or "eye," of the hurricane named "Carol" passed 80 miles to the east of the nearest watersheds. The rain amount and intensity were relatively low.

Edna. The intensities were much greater in Edna than in Carol at Freehold, Amenia, and Skowhegan. The soils were already well saturated from Carol and other local rains when Edna came along. At Presque Isle and Caribou, Maine, the prior rainfall was less, but the 1 to 2 inches of additional rain in the storm itself made up for the deficiency. The watersheds in the wettest condition before "Edna" were those at Skowhegan.

Precipitation depth and intensity data, including previous rain,
Hurricane "Edna," September 10-12, 1954, various locations

Precipitation				Maximum rainfall rate (inches per hour) by time invervals								Previous rainfall by periods		
				Minutes				Hours				Days		
Sept. date	Time began	Time ended	Total inches	5	15	30	60	2	4	6	12	5	15	31
	1/ R-2, Freehold, N. J.													
10	7:20P	--	4.53	4.32	2.12	1.22	.88	.65	.65	.53	.35	.42	2.79	3.86
11	--	2:00P												
	1/ R-2, Amenia, N. Y.													
11	12:20A	1:40P	3.67	1.32	1.04	.92	.81	.71	.54	.45	.30	.45	2.92	3.06
	1/ R-1, Skowhegan, Me.													
11	5:00A	9:00P	4.71	1.56	1.28	1.12	.90	.89	.71	.56	.36	1.72	3.35	7.07
	1/ R-2, Presque Isle, Me.													
11	3:50A	--	5.92	2.16	1.92	1.62	1.32	1.14	.94	.72	.47	.27	.97	5.19
12	--	1:00A												
	1/ R-1, Caribou, Me.													
11	1:30A	--	6.75	2.16	1.98	1.80	1.60	1.47	1.14	.86	.53	.10	.80	4.38
12	--	12:30A												

1/ R-1 and R-2 designate rain gages.

In the table that follows are given the peak rates of flow of some of the watersheds at the various locations which Edna visited. In Maine, since only the maximum stages of flow are being measured with pipe crest gages, the determination of total runoff yield is not possible. Drainage areas and flow values given in the table must be considered tentative, pending more accurate determination of size of areas and of discharge capacity of gaging stations. The rates of flow on these smaller areas are much larger on a unit area basis than they are on larger river basins. This results from the fact that even a storm as extensive as Edna will seldom cover an entire river basin, whereas selected small watersheds are significantly affected.

The past peak flows measured by the U. S. Geological Survey in Maine were not exceeded during Edna except in two cases. Near Houlton, 45 miles south of Presque Isle, Maine, the 175 square mile Meduxnekeag River had a peak flow of 37.6 cubic feet per second per square mile (former highest peak in 14 years was 31.1, May 5, 1947). In the vicinity of Portland, Maine, the 142 square mile Royal River near Yarmouth peaked at 57.7 cubic feet per second per square mile. Its previous highest peak in 18 years of record was 44.8 cubic feet per second per square mile in March 1936. These rates are 10 to 16 percent of those in the table below.

Peak rates of runoff from experimental watersheds, Hurricane "Edna" (with some runoff yield data for New Jersey and New York)

Water-shed	Location near	Acres	Peak rate of flow			Runoff yield		Miles to "eye"
			in/hr.	cfs	cfs/sq.mi.	Inches	% rain	
W-II	Freehold, N. J.	32.9	.06	2.04	39.7	.09	2.0	140
W-II	Amenia, N. Y.	76.4	.05	4.25	35.6	.32	8.9	153
W-I	Skowhegan, Me.	2060±	.59 1/	1220 1/	379 1/	no data		102
W-II	Skowhegan, Me.	61±	.56 2/	34.3 2/	362 2/	no data		102
W-B	Presque Isle, Me.	100±	.60	61.0	390	no data		82
W-A	Caribou, Me.	730±	.58 2/	424 2/	372 2/	no data		82

1/ Determined from high water marks in approach channel. Bridge footing and abutment undermined from scour during sustained flow and tipped inward. New bridge being built.

2/ Minimum values; peak flows were actually higher due to pondage back of culverts, which ran submerged at their entrances.

Farm conservation measures successful. At the Ashby Farm near Caribou, Maine, which is operated by the Maine Agricultural Experiment Station, the depths of flow in four diversion terraces and two terrace outlets have been recorded by pipe gages in the summers of 1953 and 1954. Edna produced the greatest depths of flow in these diversions (10 to 14 inches) and outlets (9 to 11 inches), but they all handled the flow without overtopping. In one 950-foot diversion terrace with a rather large drainage area, mostly in potatoes, Edna's flow had been almost equalled on July 21, 1954, when 2.50 inches of rain fell at higher intensities.

Hazel. And then on October 15 and 16, along came "Hazel" whose inland path went over watersheds under study in Maryland and western New York. To the east of her "eye" she produced more wind than rain. To the west, she tangled with other weather events and produced high amounts of precipitation over large areas. In the table that follows the precipitation amounts and intensities are given for the watersheds whose reactions will be described.

Due largely to the exceedingly dry conditions prevailing at College Park and Lisbon, Maryland, the 1.85 to 1.90 inches of rain falling during Hazel produced no runoff on four watersheds and only very small flows on the seven others. The highest rate of runoff was .008 in/hr. on W-VI, a 3.53-acre permanent bluegrass pasture at College Park. The greatest total runoff was but 0.66 percent of the rainfall, which occurred on W-V, a 1000-foot diversion terrace draining 4.07 acres in oats stubble and annual lespedeza. At Cohocton, N. Y., where it was not quite so dry, a very small runoff peak was recorded on the 2215-acre Switzer Creek drainage area, W-I. This peak was .006 in/hr. or .38 cfs/sq.mi. in comparison with the W-VI pasture at College Park, Md., of 5.22 cfs/sq.mi. No flows occurred at the three smaller gaging stations within the Switzer Creek watershed.

Precipitation depth and intensity data, including previous rain, Hurricane "Hazel," October 15-16, 1954, various locations

Oct. date	Precipitation: Time began	Time ended	Total inches	Maximum rainfall rate (inches per hour) by time intervals: Minutes 5	15	30	60	Hours 2	4	6	12	Previous rainfall by periods: Days 5	15	31
	1/ R-1, College Park, Md.													
15	5:45A	7:00P	1.85	.84	.64	.52	.46	.31	.22	.18	.15	0	.44	1.47
	1/ R-10, Lisbon, Md.													
15	6:10A	9:30P	1.90	.96	.88	.72	.45	.31	.22	.18	.16	0	.38	1.17
	1/ R-5A, Keedysville, Md.													
15	6:00A	9:30P	4.28	4.56	3.80	2.96	2.08	1.67	.65	.48	.34	0	1.31	2.37
	1/ R-5, Cohocton, N.Y.													
15	10:00A	--	.81	.72	.48	.26	.15	.13	.11	.09	.07	.36	1.58	2.71
16	--	12:15A												

1/ R indicates rain gage.

Note: The "eye" of Hazel passed to the WEST of all watersheds as follows: College Park, 42 miles W; Lisbon, 40 miles W; Keedysville, 6 miles W; and Cohocton, 31 miles W.

Near Keedysville, Md., however, "Hazel," carrying about 1.9 inches of rain at 5:00 p.m. bumped into a cold front traveling eastward from West Virginia. This collision produced, in about 90 minutes, 2.38 inches of additional precipitation of the thunderstorm type. There had also been about an inch more rain in the previous 15 and 31 days than at College Park. This combination produced the second highest peak that had occurred in 17 years of record, on the well drained 46.3 acres of W-I, Reeder Farm watershed, which was in wheat, pasture, and alfalfa. The peak rate was 1.30 in/hr. or 838 cfs/sq.mi. The erosion in the newly-seeded wheat areas on the watershed was severe. Up to 9 inches of silt and sand was deposited on the concrete apron below the weir and for 300 feet down the grassed channel below. The highest peak of record occurred on May 25, 1952, when the rate of 2.29 in/hr. was recorded from 3.13 inches of rain, 2.90 inches of which fell in about 30 minutes. Three and a half miles to the south, the slightly less well drained 80.8-acre W-II Stine Farm watershed in general crops had the highest peak of record in 16 years, which was 1.35 in/hr. or 871 cfs/sq.mi. This is 34 percent greater than the previous high peak of 1.01 in/hr. which occurred on June 22, 1939, and was caused by 1.18 inches of rain with a 30-minute intensity of 2.92 in/hr. falling on the watershed already saturated by 2.90 inches of rain.

The Reeder and Stine watersheds are a part of the larger Antietam Creek Watershed of 281 square miles. The U. S. Geological Survey peak flow measurement for Hazel was only 14.9 cfs/sq. mi. The average rainfall of 4 rain gages in the upper part of the watershed was 3.37 inches compared to the 4.28 inches at Keedysville. The maximum flow in 26 years was 27.4 cfs/sq. mi. on July 18, 1949.

Summary:

Precipitation accompanying hurricanes, though generally of lower intensity for the shorter periods than summer thunderstorms and showers, may produce high peak rates of runoff if the ground has been saturated from previous rains. In some cases, the amount of rainfall in the hurricane itself may be sufficient to saturate a watershed and still produce record flows. Hurricane disturbances may combine with local storm areas and produce extraordinary downpours which will cause floods. It seems that these hurricane storms occur often enough in the Atlantic Coast States to merit careful consideration in arriving at rates of runoff for the design of water control structures for the smaller drainage areas.

Persons who want more details may write to Mr. Hobbs.

Southeast

Florida. Surface and subsurface hydrologic studies in central and southern Florida. J. C. Stephens, Project Supervisor, Ft. Lauderdale.

Drainage Modulus Computed for Truck Farms in Everglades

It is not considered practicable to install farm drainage systems that will dispose of the maximum rainfall, and it appears to be good management to plan on losing a crop about once in 5, 10, or 15 years, the interval selected depending on the value of the crop that might be saved as balanced against the increased cost of providing drainage for very infrequent storms. A criterion used for drainage of many truck and field crops on muck is the reduction in the ground water level to a depth of 18 inches beneath the surface within 48 hours. The available soil water storage under average conditions requires about 1 inch of rain to raise the water table in the soil 6 inches. This offers an empirical method of computing the drainage modulus for truck farms in the Everglades, assuming a 24-inch water table at the beginning of storm and computing the drainage needed to reduce the water level to a depth of 18 inches in 48 hours after the storm begins. This allows a soil storage credit of 1-inch of rainfall so the computation is made as follows:

$$\frac{\text{48-hr. rainfall (inches)} - 1}{2}$$

The following table has been prepared by this method.

Computed drainage requirements for peak 48-hour rainfall, November-March, by frequency periods, Florida Everglades

	Frequency period (years)				
	2	5	10	25	50
Computed drainage requirement (inches per 24 hrs.)	0.8	1.9	2.6	3.0	4.2

Ohio. Studies of agricultural hydrology in the North Appalachian Region. L. L. Harrold, Project Supervisor, Coshocton.

Frequent Dry Periods During Growing Season Expected at Coshocton

A frequency study of periods of low rainfall during the growing season over an 18-year period, 1937-54, at Coshocton indicates that it is not an uncommon experience to have several 10-day periods each year with less than 0.1-inch rain. In fact, at least one 10-day period of no rainfall is expected every year. Every fifth year, a 20-day period of no rainfall is expected. Every 2 years, a 20-day rainfall of 0.20-inch or less may be expected.

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Michigan. Studies of agricultural hydrology in Michigan. George A. Crabb, Project Supervisor, East Lansing.

Michigan's High-Intensity Storms Come During Summers

A summarization of storms by classification shows that a majority of the low-intensity storms measured here occur in the winter season. On the other hand, the summer season is characterized by high-intensity storms. Significant correlation was noted between the occurrence of runoff and high-intensity storms.

Great Plains

New Mexico. Hydrologic characteristics of Southwestern grasslands as related to flood runoff. R. B. Hickok, Project Supervisor, Albuquerque.

In Basins of Many Sizes, Physical Features Affect Flood Lag Time Similarly

Study of data compiled by the U. S. Corps of Engineers for a large number of basins of sizes up to 6,000 square miles in the East and Midwest shows a similar general relationship between lag time and basin size as was found for the small arid land watershed (Special Flood Studies Report No. 4), indicating that the specific multiple correlation between lag time and basin physical characteristics suggested for the arid watersheds may hold over a wide range of basin sizes. (Similar data have not been published by the Corps of Engineers for large basins in the Southwest.) Data collected from the Mexican Springs, New Mexico, Experimental Watershed in 1939-43 by the SCS are now being examined for lag time relationship to basin physical characteristics of arid land basins ranging in size up to 72 square miles. There is good indication that these data will be useful in this connection.

Great Plains

Texas. Agricultural hydrology in the Texas blacklands. R. W. Baird, Project Supervisor, Waco.

Crop Yield Differences Due to Conservation Appear to Increase

An analysis of crop yields is being made for two 300-acre areas which have been farmed differently since 1942 in a study of land-use influences on the hydrology of a watershed. Preliminary results indicate that conservation practices have brought about a decided increase in per acre yields of the major crops of this area.

SEDIMENTATION

Southeast

Mississippi. Study of control of sedimentation in reservoirs, streams, and valleys of the Yazoo-Little Tallahatchie area of Mississippi. Russell Woodburn, Project Supervisor, State College.

"Plugged" Valley Study Shows Fifth of Estimated Sediment as Valley Fill

In 1936 monumented ranges were established across the valleys of several streams, including Goose Creek, in Lafayette County, Miss. The ranges were recovered and resurveyed in the fall of 1954. Sediment accumulation below a 7800-acre watershed during the $17\frac{1}{2}$ years was determined by rise in surface elevation along the ranges. Since the valley was essentially blocked below the last range studied, it was considered that virtually none of the sediment delivered from the hills to the valley had been transported through the valley and below the last range. The calculated gross erosion rate over the watershed during the $17\frac{1}{2}$-year period was 0.286 inch per year. Of this, 19.6 percent or 0.0561 inch per year from the watershed was found in the plugged valley as valley fill.

Midwest

Minnesota. Determination of capacity of the straight drop spillway, St. Anthony Falls Hydraulic Laboratory. Charles A. Donnelly and Fred W. Blaisdell, Minneapolis.

Publication on Straight Drop Spillway Stilling Basin to Be Distributed

The research report entitled "Straight Drop Spillway Stilling Basin," published as Technical Paper No. 15-B of the St. Anthony Falls Hydraulic Laboratory, has been approved for publication by the Agricultural Research Service and was sent to the printer in late December. Copies of the report will be distributed to all Engineering and Watershed Planning Units and all State offices of the Soil Conservation Service. Because the supply for free distribution is limited, requests for additional copies should be addressed to the Director, St. Anthony Falls Hydraulic Laboratory, 3rd Ave. S. E. at the Mississippi River, Minneapolis 14, Minn. This report describes the tests made to develop a new stilling basin for the straight drop spillway and gives the rules needed by the designer when he uses this stilling basin in connection with grade control structures in gullies, drainage ditches, and irrigation ditches.

Tests to determine the capacity of the straight drop spillway were continued during the quarter. With regard to the effect of approach channel depth on the discharge coefficient, we found, as have several other experimenters, that the approach floor level with the crest gave the lowest coefficient of discharge. The difference in our experiments was the use of sloping dikes instead of vertical walls to direct water to the weir.

A series of tests was run using vertical sidewalls without dikes to try to find the contraction coefficient and the effect of width of channel. An effort is being made, with little progress so far, to analyze these data and compare them with the work of Wells at the Georgia Institute of Technology, the Bureau of Reclamation, and others.

The tests to date have shown that the discharge coefficient increases as the channel narrows until W_c/L approaches 1, when the coefficient drops to approximately 3.087. The same thing is true when the toe of the dike is moved in toward the end of the crest. The highest coefficient is obtained when the toe of the dike is next to the crest.

Oklahoma. Determination of hydraulic characteristics of channels and structures for soil and water conservation. W. O. Ree, Project Supervisor, Stillwater.

Flow Retardance Properties of a Tall Sorghum Determined by Tests

Hegari, a tall variety of sorghum, was planted in 40-inch rows in a channel 20 feet wide. Flows up to 3 feet in depth were introduced into the channel at a time when the sorghum had its most lush growth. The hydraulic elements of the flow were measured and the value of Mannings n were calculated. The retardance coefficient was found to be equal to .05 when the flow depth was 0.6 feet. At a flow depth of 2.8 feet Mannings n was .15. Intermediate depths had intermediate values. The increase was due to the greater bulk of vegetation in the flow at the higher stage.